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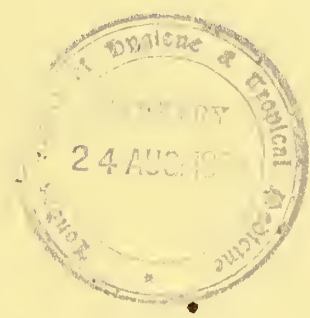
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REPORT OF THE COMMITTEE

APPOINTED BY THE

LORDS COMMISSIONERS OF THE ADMIRALTY,

TO ENQUIRE INTO

The Causes of the Outbreak of Scurvy in the recent Arctic Expedition ;

The adequacy of the provision made by the Admiralty in the way of Food, Medicine, and Medical Comforts ;

AND

The propriety of the Orders given by the Commander of the Expedition for provisioning the Sledge Parties.

Presented to both Houses of Parliament by Command of Her Majesty, 1877.

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Report to the Lords Commissioners of the Admiralty on the Cause of the Outbreak of Scurvy in the Recent Arctic Expedition; on the adequacy of the provision made in the way of Food and Medicine; and on the propriety of the Orders for provisioning the Sledge Parties.

ADMIRALTY COMMITTEE ON SCURVY,

13, DELAHAY STREET,

Sir,

3rd March, 1877.

YOU will be pleased to acquaint the Lords Commissioners of the Admiralty that, in pursuance of the instructions contained in your letter of the 9th of January last, we, whose names are hereunto subscribed, having heard and duly considered the evidence of the Commander; of the Principal Officers, and certain of the inferior officers and men of the late Arctic Expedition; of Officers and Men who have taken part in previous Arctic voyages; of the Medical Director-General of the Navy; and, after communication with the Royal Colleges of Physicians and Surgeons, of Eminent Medical authorities; have to report as follows, on the matters submitted for our inquiry:—

First.—The Cause of the Outbreak of Scurvy.

We attribute the early outbreak of scurvy in the spring sledging parties of the Expedition to the absence of lime juice from the sledge dietaries.

We are further of opinion that the long winter, extending over 142 days, involving, during that period, absence of sunlight, confinement during the greater part of the twenty-four hours to a lower deck, of necessity not free from damp, and an atmosphere comparatively vitiated, accompanied by exposure to extreme changes of temperature and deprivation of fresh meat—especially in the “Alert”^{*}—had not been without effect on the health of the officers and men, notwithstanding the apparent good condition in which they started on their sledging journeys.

These predisposing causes of scurvy were aggravated by the severe cold and arduous labour encountered by the sledging parties immediately on leaving their ships, followed by the usual results, inability for some days on the part of those concerned to take their proper allowance of food and to obtain sufficient sleep.

How far, with due regard to the length of the travelling season, dependent on the breaking up of the ice in the Arctic Sea, these evils could have been mitigated by a recourse to short journeys, utilized for laying out depôts of provisions, and other preparatory purposes, prior to those of a more extended character undertaken to effect the main objects of the Expedition, we are not prepared to say, but it is obvious that the adoption of such a system would have afforded an amount and description of that previous training so essential to the success of sledging, far more efficacious than the exercise obtained during the winter, but limited by its severity.

Secondly.—The adequacy of the provision made by the Admiralty in the way of Food, Medicines, and Medical Comforts.

We find that the provision made in the way of food, medicines, and medical comforts, was in every respect adequate for the performance of the special service in which the Expedition was engaged, and more complete than that made for any previous Expedition which has proceeded on Arctic Service.

In reference to which we forward the following returns:

- (1) Provisions, medicines and medical comforts supplied to the Expedition on leaving England, and received back into store on its return.
- (2) Savings during the winter of 1875–76.
- (3) Reports on such articles of provisions as have been analysed by direction of the Committee.
- (4) Report of survey on certain articles of provisions to which exceptions were taken in the evidence tendered to the Committee.

* Number days on which fresh meat was issued “Alert” .. “Discovery”

Thirdly.—The propriety of the orders given by the Commander of the Expedition for provisioning the sledge parties.

We find that the orders of the Commander of the Expedition for provisioning the three extended and principal spring parties did not include lime juice, thereby deviating from the 11th Article of the Memorandum of Recommendations and Suggestions of the Medical Director-General, furnished by their Lordships for his information, and that the reasons assigned for such deviation being insufficient, the said orders were not proper.

We forward a paper on scurvy drawn up by the Medical Members of the Committee, which will bring to their Lordships' notice the prevailing view of the Medical Profession in regard to this disease, some exceptional cases of immunity from scurvy deserving of further investigation, together with such suggestions in regard to the prevention and treatment of the disease, the use of lime juice and other antiscorbutics, as the professional evidence tendered to the Committee leads them to consider may prove of general interest.

In the memoir entitled "Description of Travelling Equipments," furnished by Rear-Admiral Sir F. Leopold M'Clintock, Kt., for the use of the Expedition, we find the following recommendation :—" With a view to retain and to add to our present knowledge of Arctic Travelling Equipment, I request that, at the close of the Expedition this manuscript, compiled by me for its use, may be returned to the Admiralty, accompanied with the remarks on each article of those officers and men who have been most employed in sledge travelling, and gathered from them after all the sledging has terminated."

We bring this recommendation to their Lordships' notice, in the hope that it will be complied with ; and we are of opinion that analogous reports in regard to the food, medicines and medical comforts of the Expedition, will prove of equal service.

For their Lordships' further information we add—

- (5) A Summary, showing the days on which the Committee sat, and from whom the evidence was received.
- (6) Index of Papers which were called for by the Committee, and which will form the Appendix to the Evidence.
- (7) Index of Papers which were called for by the Committee, and not placed in the Appendix, but which should be preserved for future reference.

We have directed our secretary to forward to you the Evidence, accompanied by the requisite Appendix and Index, as soon as it can be prepared.

J. HOPE.
RICH^d. COLLINSON.
E. A. INGLEFIELD.
JAMES DONNET, M.D.
THOMAS. R. FRASER, M.D.

*To Rear-Admiral Robert Hall, C.B.,
Secretary to the Admiralty.*

PAPER ON SCURVY.

BY DR. DONNET AND DR. FRASER.

In the following paper on Scurvy, drawn up at the request of the Committee, we have endeavoured, with as much brevity as is consistent with the object in view, "to bring to their Lordships' notice (1) the prevailing view of the Medical Profession in regard to this disease, (2) some exceptional cases of immunity from scurvy deserving of further investigation, (3) together with such suggestions in regard to the prevention and treatment of the disease, the use of lime juice and other antiscorbutics, which the professional evidence tendered to the Committee has led" us "to consider may prove of general interest." We have also ventured, in connection with the first subdivision of our subject, to allude to some of the more salient points of the outbreak of scurvy in the recent expedition, in order to show in what respects this outbreak, in its history, and more especially in its causation, may be considered to harmonize with the prevailing views of the Medical Profession regarding this disease.

I. SYMPTOMS, PATHOLOGY, AND CAUSES.

The evidence given to the Committee has reference to scurvy, not only as it appeared in the Arctic Regions, but likewise in Africa, Asia Minor, the Crimea, India, Australia, and various parts of the United Kingdom. In every place where observed, the distinctive characters of scurvy were unchanged. Instances also have been given in evidence which prove that the disease is not confined to the White Race, but is met with in the Negro, the Lascar, the Indian, and the Esquimaux, and presents the same essential characters in all races.

Symptoms.—The symptoms which are observed in the course of scurvy, and which characterise the disease, are shown in evidence to be as follows:—The colour of the face changes, the skin grows sallow and assumes a leaden hue, and the countenance may afterwards become bloated, and the eye assume a heavy expression. A general debility prevails, and an apathy of manner is noticed; there is feebleness of the knees and ankles, and pains—resembling the flying pains of rheumatism—attack various parts of the body. Swelling of the joints, with rigidity, accompany these symptoms. This rigidity is especially observed in the hams, for which site a predilection seems to exist in the case of men engaged in walking exercise. The gums swell, grow spongy, and bleed from the slightest cause. The breath becomes fetid. The skin is dry and rough; and petechiæ are observed about the legs and thighs, as small reddish brown specks at the points where the roots of the hair perforate the skin. Sleep at this period of the disease is readily obtained; the appetite usually remains good; there is some constipation, but no fever. Sometimes, there is breathlessness with sense of tightness of the chest, for which auscultation generally fails to reveal a cause. Night blindness has sometimes been observed as a symptom of scurvy.

With the advance of the disease the symptoms become aggravated, the petechiæ extend, coalesce, and assume the form of large maculated patches; the skin loses its elasticity, readily pits and frequently breaks, and the ulcer which follows assumes a spongy appearance, and resembles what sailors graphically term "bullock's liver." The smell from this ulcer is offensive.

The low spirits become confirmed, and the unfortunate patient indulges in the gloomiest of ideas; the fetor of the breath is now intolerable; the gums protrude as spongy masses* from the mouth; the teeth become loose in the socket, and frequently fall out.

In this advanced condition, every slight scratch degenerates into an ulcer, old scars break out afresh, and hæmorrhages are now frequent from different parts of the body

* It is to these spongy masses that Jean, Sire de Joinville, in his "Histoire de St. Louis," alludes in the following passage:—

"La maladie commença à engregier en l'ost en tel manière, que il venoit tant de char morte ès gencives à nostre gent, que il convenoit que barbiens otassent la char morte, pource que il peussent la viande mascher et avaler aval. Grant pitié estoit d'oïr brèrre les gens parmi l'ost, ausquies l'en copoit la char morte; car il bréoiert aussi comme femmes qui travaillent d'enfant."—(The disease increased in our camp to such a degree as to cause large masses of dead flesh to spring from the gums of our people. The barbers were forced to cut away the dead flesh to enable the patients to eat. It was pitiful to hear the cries of those on whom this operation was performing; for they cried like women in labour.)

in the form of epistaxis, hæmoptysis, hæmatemesis, hæmaturia, and scorbutic dysentery. The urine is high coloured and small in quantity; the pulse is small and indicates a weak state of the circulation.

The mind is anxious and desponding, the intellect is clear, but towards the latter end this anxiety and despondency give way to apathy and indifference.

The breathlessness, which was remarked at the onset of the disease as a troublesome but not a continuous symptom, now increases, is frequently attended with faintings, especially on any exertion, and is sometimes accompanied with sanguineous effusion into the substance of the lung, and into the pleuræ and other cavities. Death occurs suddenly in many instances.

Pathology.—The examination which has been made of the bodies of men who have succumbed to scurvy has shown that the morbid appearances chiefly relate to the effusion into the cellular tissues of the body; these are the peculiar characteristics of scurvy. There are solid fibrinous effusions in the substance of the gums, and more especially in the intermuscular spaces, more abundant usually in the lower extremities than in the upper, there are also fibrinous effusions between the periosteum and the bone, constituting what are termed scorbutic nodes. The colouring matter of the blood, also, may ooze through the walls of the vessels without the rupture of the vessels. The viscera generally are not affected.

The blood is reduced in density, it contains a greater quantity of water and fibrine, and a smaller quantity of red corpuscles, albumen, and inorganic constituents than healthy blood, and it exhibits an abnormal tendency to coagulate. These characters cannot, however, be regarded as the essential conditions distinctive of scurvy; they represent only incompletely the deterioration of the blood that exists as a result of depraved nutrition.*

Causes.—The evidence is all but unanimous that the want of fresh vegetable food, or of some of the constituents which compose fresh vegetable, and probably also fresh animal, food is the cause of scurvy.

What Mr. Busk said with regard to the causation of the disease, seems to embrace the general spirit of the evidence. He considered scurvy to be “essentially a consequence of defective rather than of deficient nutrition a species of starvation,” due to the want of “a particular element, of the nature of which we are entirely ignorant,” but which is, “according to most authorities, afforded solely by fresh vegetable juices; whilst some are of opinion that fresh animal flesh, in the raw state more especially, and milk, are also possessed of powerful antiscorbutic properties.” (5249).

The opinions of the majority of the Medical witnesses who had observed scurvy and had made a study of it, coincided with the above, and were as follows:—

Dr. Pavy.—“Observation has shown us that scurvy depends upon the absence of “the proper quantity of succulent fresh food” (5150), “or its representative, some “kind of vegetable juice” (5152). Sir Robert Christison, quoted by Dr. Pavy in his evidence, says: “But all observers and authors of credit insist on the necessity of some “dietetic error as the cause of scurvy” (5191).

Dr. Guy.—“The absence of succulent vegetables from a dietary is the usual, if not “the invariable cause of outbreaks of scurvy” (5316).

Dr. Barnes.—“The only one constant condition is the privation of vegetable food” (7032) “Scurvy is a disease of a gradual breaking down of the nutritious qualities “of the blood, the gradual result of the deprivation of vegetable food” (7108).

* Mr. Busk, whose attention has been especially directed to the appearances which the blood of a scorbutic patient presents, says:—“From what is known of the character of the blood in scurvy, it may perhaps be surmised that the changes from the normal condition presented by it are due to its not being renewed with the “same rapidity, or to the same extent, as it is continually being renewed under most other circumstances. In “other words, there is, what may be termed, an arrest of development—an atrophy of the blood, which consequently demands a variable length of time, proportionate, one may suppose, to its greater or less richness, “if one may use such a word, or to the greater or less activity of the exhaustive agencies to which the “system is exposed, becomes at length unfit any longer to perform its normal function in the maintenance “of heat and the supply of energy and material for the different vital processes, but pre-eminently for those “of the muscular system.”

“With regard to the cause or causes by which this condition of the blood is brought about, though “the rationale of its or their action is quite unknown, there can be no doubt, as a matter of fact, that the “principal, if not the sole cause of true scurvy is the absence of fresh vegetable juices, or, as some suppose, “and as I think with sufficient reason, of fresh animal juices—meaning by ‘fresh’ the juices of uncooked “flesh. What may be the nature of the deficient element is at present altogether unknown, we can “therefore merely regard the effect produced by its absence in the light of an ultimate fact.”

Dr. Buzzard.—"Scurvy is a peculiar state of mal-nutrition, supervening gradually upon the continued use of a dietary deficient in fresh vegetable material, and tending to death after a longer or shorter interval, if the circumstances under which it arose remain unaltered" (5422).

Dr. Macdonald.—"It is the deprivation of vegetable food which is the cause of scurvy" (4891).

Dr. De Chaumont.—"The principal, if not the only cause of scurvy, is the want of fresh vegetable food, or at any rate of some of the constituents which compose fresh vegetable food" (4976).

Dr. Leach.—"I class the causation first to the want of antiscorbutics, such as lime juice, or any other class of fresh vegetable food, and the bad quality of animal diet, or insufficient quantity of animal diet" (5542).

Dr. W. Dickson.—"I believe it to be a purely dietetic disease" (5652). "I consider that the immediate and direct cause of the outbreak was the privation of fresh vegetable food, or its substitute, lime juice" (5619).

Dr. Rae.—"I consider scurvy a blood disease, caused by a deficiency of something that it gets from vegetables (8876), and that when you have no vegetable or no bread, there is something that the system wants which is in very small quantity in animal food, and therefore you have to eat a very great deal more than you want in order to get at this quantity from the meat" (8784).

Dr. Munro.—"Scorbutic symptoms were general among the troops in the Crimea, the cause in operation was 'the absence of fresh vegetables'" (8548).

Sir Alex. Armstrong.—"The absence of fresh vegetable food of itself would cause scurvy" (8959).

It is proper to observe, that notwithstanding the almost unanimous evidence in favour of the opinion that scurvy is caused by a deficient supply of fresh vegetable food, other opinions have been advanced by eminent authorities. The chief of these are the opinion of Sir Robert Christison, that a deficiency of the nitrogenous principles of food, and especially of albumen and casein, is a cause of scurvy; that of Dr. Garrod, which refers the production of the disease mainly to the absence of potash; and that of Dr. Aldridge, which assigns the greatest influence in the production of the disease to the absence or deficiency of phosphorus, sulphur, lime, potash, and soda. The arguments in support of these opinions have not, however, been sufficient to lead to the general adoption of any of them, nor has any of these opinions been advanced in the evidence afforded to the Committee. That evidence very decidedly refers the production of scurvy to the absence or deficient supply of fresh vegetable food or of its constituents; and there can be little doubt that in doing so, it gives expression to the generally accepted opinion.*

Although scurvy be essentially a disease of mal-nutrition, having as its invariable antecedent a deficiency or absolute want of certain substances usually supplied by fresh vegetable food, there are various conditions which, though of themselves insufficient to produce the disease, powerfully contribute to its early appearance, and aid in its development. Generally described, these conditions are such as interfere with nutrition and lower the standard of health. The more prominent of them seem to be illness from intermittent fever, cholera, or dysentery; deprivation of the sun's light; an impure or damp atmosphere; cold; want of sufficient exercise; a dietary deficient in fresh meat; and fatigue. Many of these concurrent antecedents, or secondary causes, have been referred to in the evidence, and are described in the history of the sledge journeys; but in order to appreciate the importance of such of them as existed in the recent expedition, it may be convenient to advert to some of the leading incidents of the expedition.

Manned by carefully selected crews, and provided with supplies of food, medicines and medical comforts on a scale probably more liberal than that of any previous expedition, the "Alert" and "Discovery" sailed from Portsmouth on the 29th of May, 1875. After an "unprecedented passage" the "north water" was entered on the 25th of July; and the obstacles of Smith Sound and Kennedy Channel having been successfully encountered, the "Discovery" was secured in her winter quarters in Lady Franklin

* In August 1874, M. Villemin presented to the Academy of Medicine in Paris a Memoir (*Causes et Nature du Scorbut*) in which he attempted to prove that scurvy, far from being the consequence of deficient nutrition, was "une maladie endémo-épidémique, contagieuse, analogue au typhus, à la peste, et résultant d'un miasme particulier." In the following October (*Séance du 20 Octobre, 1874*) this opinion was ably and exhaustively combated before the Academy by M. Alfred Le Roy de Méricourt, whose experience of scurvy, as Medical Officer of the French Navy at Brest, as well as in India, Newfoundland, the Crimea, and Paris during the two sieges of 1870 and 1871, entitles him to express with some authority an opinion on this subject.

Sound (latitude $81^{\circ} 44'$ North), on the 25th of August. After considerable delays, owing to constantly increasing difficulties in her northward progress, the "Alert" was, on the 2nd of September, in her turn secured in winter quarters near the north entrance of Robeson Channel, in latitude $82^{\circ} 27'$ North, a higher latitude than any vessel had ever before attained. The crews of the two ships were now occupied in preparations for the approaching winter; and expeditions, generally extending over a few days, but in one instance over so long a period as twenty days, and consisting of man and dog-sledges, were sent from each ship in order to explore the neighbouring coasts, and advance boats and stores of provisions in anticipation of the more important sledge expeditions to be undertaken during the following spring and summer. With the disappearance of the sun, on the 12th of October in the case of the "Alert," and on the 16th of October in the case of the "Discovery," the long arctic winter was entered upon, the sledge expeditions ceased, and the crews began the winter's routine which terminated only when the sun reappeared on the 29th of February, 1876, in the case of the "Discovery," and on the 1st of March in that of the "Alert."

The occupations of this prolonged winter included amusements of various kinds, and much besides to serve as interesting employment; but it was necessarily attended with comparatively little exercise in the open air, as well as by confinement on board ship for many hours during each day. Sir George Nares, however, was, at its termination, able to report that it "was passed by each individual on board with much cheerfulness and contentment."*

During this winter, and for some time anterior to it, the crews had been fed on a diet of a liberal description, in which the vegetable element was fairly represented, and daily rations of one ounce of lime juice were served out; while variety was obtained—occasionally in the "Alert," and frequently in the "Discovery"—by the issue of fresh meat.† It is worthy of note that the ration of rum was increased from half-a-gill to one gill from the 16th of October, 1875, to the 29th of February, 1876, in the "Discovery," and from the 26th of October, 1875, until the 3rd of April, 1876, in the "Alert."

On the reappearance of the sun, active preparations were made, during the month of March, for the spring sledging operations, which began early in April; but the diet on board ship continued to be represented by the winter scale, with the exception that a double allowance of lime juice was served out on board the "Alert" from the 4th of March until the 3rd of April. The number of men on board each ship at this time was as follows:—"Alert," 14 officers and 56 men (including 1 officer and 7 men from the "Discovery," who wintered in the "Alert"); "Discovery," 12 officers and 40 men. There is abundant evidence to show that the health of these 26 officers and 96 men was considered to be satisfactory during the winter and until the commencement of April (426, 560). Dr. Colan, of the "Alert," stated that the health of the men under his medical care was remarkable during the winter of 1875 and until he examined the men for the general sledging. "Taking the usual run of the service, it was better during that time than was that of the general run of ships that I have ever had" (1627). Dr. Moss, also of the "Alert," when invited to state his "general opinion of the physical condition of the men and their state of health immediately prior to the 3rd of April," replied,— "With one or two exceptions, I looked upon all as in good health and physical strength" (2203). Dr. Ninnis, of the "Discovery," when asked if the 52 men of his ship had good health until spring, replied,— "Very good health until the 1st of January or the beginning of the year, when I had my first case of scurvy" (2512); and, on being further asked if he was satisfied with the health of his crew, with the exception of this case, he answered,— "Perfectly. I think that everybody was in thoroughly good health; in fact, I am sure of it" (2532). Dr. Coppinger, of the same ship, considered that the health of the crew of the "Discovery" was generally satisfactory during this period, and that the absence of light and the confinement did not produce any obvious effects upon their health, except in the case of one man who suffered from scurvy during winter (2832–2834). Those opinions are confirmed by the "Returns of Sick and Wounded" prepared by Dr. Colan and Dr. Ninnis, the Senior Medical Officers of the two ships; which show that the illnesses were few in number and generally of a trivial nature—several cases of frost-bite and one of scurvy being excepted. It further appears from these returns that, within this period, the cases of illness were considerably more numerous on board the "Discovery" than on board the "Alert."

A new stage in the history of the expedition was entered upon with the commencement of the sledging operations early in April, and from this time until the end of

* Report of Proceedings, Arctic Expedition, 1875–6 (C.—1636), p. 18.

† See Report of Dietary of "Alert," Appendix No. 3; and of "Discovery," Appendix No. 10.

ALERT.**DISCOVERY.***Complement.*

Number of officers and men ..
 Number lent from "Discovery"
 who wintered in the "Alert" ..

Total number who wintered in the
 "Alert"

Officers.	Men.	Total.
13	49	62
1	7	8
14	56	70

Complement.

Number of officers and men ..
 Number lent to the "Alert" before
 the winter of 1875-76, and who
 wintered in the "Alert" ..

Total number who wintered in the
 "Discovery"

Officers.	Men.	Total.
13	47	60
1	7	8
12	40	52

Cases of Scurvy.

Number of cases among men of
 the "Alert"
 Number among men of "Discovery"
 who wintered in the "Alert" ..

Total number among the men who
 wintered in the "Alert"

Officers.	Men.	Total.
3	37	40
0	5	5
3	42	45

Cases of Scurvy.

Number of cases among men of
 "Discovery"
 Number among men of "Discovery"
 who wintered in the "Alert" ..

Total number among the men who
 wintered in the "Discovery" ..

Officers.	Men.	Total.
2	18	20
0	5	5
2	13	15

Deaths from Scurvy.

Number of deaths among men of
 the "Alert"
 Number among men of the
 "Discovery" who wintered in
 the "Alert"

Total number among the men who
 wintered in the "Alert"

Officers.	Men.	Total.
0	2	2
0	1	1
0	3	3

Deaths from Scurvy.

Number of deaths among the men
 of the "Discovery"
 Number among men of the
 "Discovery" who wintered in
 the "Alert"

Total number among the men who
 wintered in the "Discovery"

Officers.	Men.	Total.
0	2	2
0	1	1
0	1	1

The men of both ships were during the winter subjected in nearly equal degree to the effects of confinement, dampness, cold and extreme changes of temperature; the men of the "Alert" experienced a somewhat more prolonged absence of sun light, and a decidedly greater deficiency in the quantity of fresh meat than the men of the "Discovery"; while the men of the latter ship were probably subjected to a more impure atmosphere than the men of the former. All of these conditions operate prejudicially to health, and reduce physical strength. They may thereby favour the development of scurvy, in common with other forms of disease; but the evidence given to the Committee is pointedly opposed to the opinion that they could produce scurvy in men subsisting on a diet in which the vegetable element was fairly well represented, such as that used on board the two ships during the winter.* Were they in any sense essential antecedents to this disease, the majority of the cases would certainly have occurred while they were in action, and not after they had for several weeks ceased to operate, and conditions of a totally different character been substituted for them.† That the position should have been assigned to them of essential causes, or even of the most important of the accessory causes, seems due to the fact that in the history of this outbreak there were certain circumstances of a remarkable and noteworthy description for which an explanation appeared most readily to be found among the conditions that existed on board the ships during the winter. These circumstances are: (1) the great disparity between the number of cases in the men of the two ships, and (2) the unusually early occurrence of several cases after what is generally regarded as the essential antecedent of scurvy came into operation.

* 4994; 4910-4912; 5307; 5351-5358; 5437-5450; 5603-5606; 5619-5620,

† See experience of the Austrian Ship "Tegetthoff," in "New Lands within the Arctic Circle," by Julius Payer, Vol. I., p. 313 (1876).

1. *The great disparity between the number of cases in the men of the two ships.*—A reference to the tables shows that 45 men among the 70 who wintered in the “Alert” (or 64 *per cent.*) were affected with scurvy, whereas only 15 men among the 52 who wintered on the “Discovery” (or 29 *per cent.*) were affected. Two of the conditions that were present in different degrees in the two ships have been thought accountable for this great disparity. These are the somewhat more prolonged absence of sun light, and the much greater deficiency of fresh meat, to which the men of the “Alert” were subjected.

The first, however, was merely a difference of four days—the “Discovery’s” men having been deprived of sun light for 138 days and the “Alert’s” men for 142 days—and cannot of itself account for a difference of 35 *per cent.* in the numbers affected proportional to the crews of the two ships.

The second constitutes a much more marked difference. It appears from the evidence and the reports of the Commanding Officers of the two ships, that fresh meat, chiefly in the form of musk-ox beef, was served out, during the winter’s confinement, only 14 times on board the “Alert,” (2075) whereas it was served out 53 times on board the “Discovery (Appendix No. 10).” To the extent represented by this difference, the “Alert’s” men were supplied more largely with the preserved and salt meat carried by the ships; which, although of good quality, is not considered so well fitted as fresh meat to maintain a high standard of health. The positive advantage was also enjoyed by the “Discovery’s” men of obtaining more frequent supplies of a food which has acquired, probably on sufficient grounds, a high reputation as a prophylactic against scurvy. This reputation is mainly founded on experiences in which enormous quantities of fresh meat were consumed (as $3\frac{3}{4}$ lbs. or even 8 lbs. of fresh venison daily*), or in which the fresh meat was eaten raw,† by men who did not suffer from scurvy, although conditions were present favourable to the production of that disease. On board the “Discovery,” however, fresh meat was issued at irregular intervals; the ration for a short period was only one pound three to four times a week, and for a more considerable period one pound and a-half once a week; and the meat was eaten in the ordinary cooked form. That fresh cooked meat, consumed in these quantities, possesses the power of preventing scurvy in the presence of conditions otherwise sufficient to develop that disease, cannot be assumed from any existing data (2385, 2388, 2389, 2639, 4851, 5268, 5423, 5424, 5525). The evidence is undoubtedly against this supposition, and even more so against the supposition that any antiscorbutic power can be exerted by such consumption for several weeks after the consumption had altogether ceased. The latter supposition must be maintained in order to assume that the greater immunity from scurvy among the men who wintered in the “Discovery” was due to the greater quantity of fresh meat consumed by these men during the winter; for with the exception of one case that occurred on board the “Discovery” in winter, all the cases in this outbreak and in both ships occurred during the sledging season, and not until several weeks after the last preceding issue of fresh meat on board the “Discovery.”

2. *The unusually early occurrence of several cases of scurvy after what is generally regarded as the essential antecedent of scurvy came into operation.*—Although the majority of the cases of scurvy did not occur until several weeks after the sledge expeditions had left the ships, still there were several cases which originated only a few days after the starting of these expeditions, and in men who had enjoyed good health during the winter. The earliest of these were connected with two of the three most important sledge expeditions, the Northern under Commander Markham, and the Eastern under Lieutenant Beaumont. In Commander Markham’s party, John Shirley became ill on the eleventh day, George Porter on the twelfth day, and Alfred Pearce on the sixteenth day; and other cases followed in quick succession. In Lieutenant Beaumont’s party, James Hand became ill on the seventeenth day after the expedition left the “Alert.”

The occurrence of these, and of several other cases which made their appearance early in the sledging season, seems to have been the main reason for the expression of opinions such as the following, which appear in the evidence:—“It is evident that “twelve days of travelling did not give these men scurvy, if so, it is contrary to all “previous experience” (3045); “I believe the disease manifested itself within a few “days after leaving the ship, and I think it is impossible that the disease could have “shown itself if the seeds had not been sown in winter” (3986); “Taking the sledge “parties alone, from the fact of scurvy breaking out among the sledge crew or crews ten

* Dr. Rae, Paper handed in to the Committee, Appendix No. 27, also 8710 and 8779 of Evidence; and Admiral Pullen, 6105.

† Kane’s “Arctic Explorations,” London, 1876, p. 263; Dr. Pavy, 5159 of Evidence; 4925.

"or eleven days after their leaving the ship, my opinion is that they were scorbutic before they left" (4689); "I think that these men, when they started on the sledging expeditions, were already scorbutic" (5454); "The circumstance, therefore, that in the late expedition, in the sledging parties, the disease made its appearance in some cases within a fortnight, affords to my mind almost conclusive evidence that the men were not really as vigorous as their appearance seemed to indicate" (5249).

In so far as these opinions imply merely that the conditions to which the men were subjected during the winter had produced a deterioration of health conducive to the development of scurvy in common with other diseases, they may be regarded as justified by the general observation of the effect of these and similar conditions. Their justness, however, cannot be so readily assumed when they imply that because the interval between the commencement of the operation of the alleged essential cause of scurvy and the first obvious appearance of the disease was a brief one, therefore the alleged cause could not have been the true cause, but rather that the true cause is to be found among the conditions existing at a more distant period.

It is not, as appears to be assumed, an unprecedented circumstance in the history of scurvy, that cases of the disease should occur within a few days after new conditions, and presumably the effective conditions, had come into operation. In the memorable voyage of Anson round the world, one of the ships of his squadron, the "Centurion," set sail from St. Helens, Isle of Wight, on the 18th of September, 1740; and after a run to Madeira, which occupied an unusually long time, and was accompanied with much sickness from fever, proceeded to the island of St. Catharine, on the coast of Brazil, and thence to St. Julian, on the coast of Patagonia. The time spent in reaching St. Julian was 152 days, the ship having remained for 9 days at Madeira, and for 29 days at St. Catharine. After a stay of 10 days at St. Julian, the crew sailed from that port in good spirits, and as far as can be learned in good health. The next destination was Juan Fernandez, and 105 days was occupied in reaching it. The present interest of the narrative centres in the incidents of those 105 days, which were spent, to quote the words of the narrator, "amid storms, cold, frost, and deluges of water, under unparalleled exposure, fatigue, and privation." "In about 10 days after leaving St. Julian the scurvy began to show itself, and in less than two months it had spread to such a degree that there were few on board free from it."*

The conditions that existed on board the two ships during the winter do not therefore appear to have had any direct causal relationship to the outbreak of scurvy that subsequently occurred; nor, indeed, do they appear to have affected the health of the crews in any distinct or appreciable manner. That some deterioration of health, some interference with nutrition, rendering men more susceptible of disease, did occur however, must be inferred from the very nature of the conditions. This inference receives support from the fact, that during the autumn preceding this winter, sledge expeditions were undertaken, which in some of their conditions resembled those of the subsequent spring and summer, but which nevertheless were not attended with scurvy.

Board Ship Dietary.—Before passing from the consideration of the circumstances existing during the winter, it may be advisable to refer to the dietary then in use. The full reports, prepared by the Commanding Officers of the two ships, contain all the information requisite for forming an opinion of the sufficiency of this dietary. It has already been stated that it was supplemented by the daily issue of at least one ounce of lime juice, and that it was at times modified by the substitution of fresh meat for preserved and salted meat, this modification having taken place more frequently in the "Discovery" than in the "Alert" (Appendix, Nos. 3 and 10).† A large number of the substances mentioned in this dietary have been examined by the Committee, and their quality was found to be in every respect excellent, with the single exception that the salt beef was stated to be oversalted. Several of the foods, also, including the lime juice, have been analysed by the direction of the Committee; and the reports of the eminent chemists who have undertaken this duty have shown that the foods submitted to them are of good quality (pp. xxii—xxx). It is interesting to find that the processes of preservation had in no respects impaired the quality or nutritive value of the moist preserved vegetables, such as the tinned carrots, nor of the dry preserved potatoes (Edwards'). The latter is of special importance, as the antiscorbutic reputation of the potato, in its ordinary form, is great and fully established. The analyses of the dry vegetables, represented by compressed cabbage and compressed mixed vegetables, yields

* Public Health: A Popular Introduction to Sanitary Science. By William A. Guy, M.B., &c. 1874, pp. 154, 156.

† 7950, 8100, 8101, 8189–8222, 8382, 9303.

results which are not so satisfactory; as certain of their saline constituents were found to be deficient. No deleterious effects, however, can be traced to this deficiency, but it is impossible to decide whether this be due to the unimportance of the deficiency, or to the fact that it was supplemented by the saline ingredients contained in the other vegetables and foods used on board the ships.

The Committee also received much interesting information respecting the productive value, in supplying force and, indirectly, in affording nourishment, of this dietary (4998, 5323-5326). The dietary has generally been pronounced to be an adequate and well arranged one (3263, 4902, 5249, 5324), and to quote Dr. De Chaumont's words, "a very good diet, indeed, and quite sufficient for the purpose" (4998). The men remained in good health, and even gained in weight, while subsisting upon it (2027, 9139); nor did scurvy occur among any of the men who had been restricted to this scale of diet, with the exception of the one case on board each of the two ships, to which allusion has already been made (pp. ix and x).

At the termination of this winter's confinement, the sledging season commenced, during which 59 cases out of the 60 in this outbreak made their appearance, one of the 59 being the case of the "Alert's" steward, already referred to (p. ix). It is therefore important to consider what conditions existed during this season prejudicial to health, and to what extent they were conducive to the scorbutic disease that appeared.

Among the requirements of sledge travelling, and especially of extended journeys, is the reduction to as small limits as possible of the weights carried. The weight of many articles of food may now be greatly reduced without any obvious impairment of nutritive value, by the abstraction of a portion of the water they naturally contain, this water being returned during the process of cooking. Condensed foods are for this reason used as largely as possible by sledge parties; and several are represented in the sledge dietary of the recent expedition, such as preserved potato and pemmican. It must be recollected that the water is only temporarily removed from these condensed foods, otherwise a wrong impression may be produced on comparing the scheme of diet used on board the ships with that of the sledge parties of the recent expedition. The total weight of food for one man per diem represented by the former is 321 ounces, and by the latter 275 ounces (Appendix Nos. 3 and 10), no allowance being made for the water temporarily abstracted from foods in both schemes. When, however, the foods are reduced to the state of water-free solids, and the board-ship dietary compared with that of the sledge parties, it is found that the former dietary is in reality a less liberal one than the latter, as it contains only 27.44 ounces of water-free solids while the sledging dietary contains 35.65 ounces. Further, it has been estimated that 340 foot-tons of productive work could be done without loss of weight on the former diet, and so much as 585 foot-tons on the latter (4999, 5000).

It has already been stated that the board-ship dietary was apparently a sufficient one for men in the conditions of the crews during the winter, and that it was well fitted, especially with the accompanying rations of lime juice, to protect men against scorbutic disease. These statements are confirmed by the medical reports for the winter season.

It is now necessary to consider what opinion may be formed on these points respecting the dietary of the sledge parties.

The expeditions during the sledging season varied greatly in their duration and in the hardships and physical exertions that accompanied them. The most prolonged were the three extended sledge expeditions, that to the North under Commander Markham, to the East under Lieutenant Beaumont, and to the West under Lieutenant Aldrich; and it would appear that the physical exertions undergone by the men, as well as the exposure to vicissitudes of climate, were greater in these than in any of the other sledge expeditions.

The following extracts (to some extent abridged), from the Journals of the Commanding Officers may serve to give some idea of the exertions undergone by the men, and of the trials to which they were subjected:—

Commander Markham's Journal of the Northern Exploring Division between April 3rd and June 14th, 1876:—

"April 3rd.—Left the ship at 11 A.M. Therm. — 33° Snow deep, and the sledges dragging very heavily. 5.30 P.M., men showing signs of fatigue. Halted for the day after 5½ hours on the march.

"April 4th.—Passed a cold, wretched, and sleepless night. Temp. inside tent, — 15°. Few men able to partake of their pemmican either last night or this

" morning. Although our foot gear was placed inside our sleeping bags, nothing thawed, everything was frozen quite hard in the morning. Travelling on the floe is extremely heavy, and we are compelled to double-bank all sledges, thereby making but slow progress. Men getting tired, halted at 4.45 P.M. John Radmore had all the toes on his left foot frost-bitten, but fortunately it was taken in time and circulation restored. Our sleeping bags resembled sheet-iron. Hungry enough to eat our full allowance of pemmican at supper. Temp. outside tent, — 35°.

" *April 5th.*—Temp. inside tent last night as low as — 25°. We all slept a little more comfortably, or rather a little less uncomfortably, though deprived of all feeling in our feet. The men appear a little stiff, and complain of having suffered a good deal last night from pain in their limbs and are to-day suffering from great thirst. The travelling has not improved and the temp. has been as low as — 45°.

" *April 6th.*—Another cold sleepless night over. Everything frozen stiff and hard. Dressing by no means an easy operation. Temp. — 35°.

" *April 7th.*—Started with the Northern Division at 8 A.M.; a beautiful day, but very cold. A few slight frost-bites, but quickly restored. Daniel Harley rather severe in big toe. Heavy floes fringed with hummocks, through and over which the sledges have to be dragged. Temp. — 41°.

" *April 8th.*—Occasionally brought to a standstill by a belt of more than ordinarily large hummocks, through which we have to cut a road with pickaxes and shovels. Sledges double-banked as before. Glare of sun oppressive. A few of the party, including Parr and myself, suffering from snow-blindness. Temp. — 31°.

" *April 9th.*—Snow still very deep, materially retarding our progress. Temp. — 34°.

" *April 10th.*—Our weights are exactly as they should be, namely, 6,080 lbs. to be distributed on the three sledges. Thus loaded the sledges will drag uncommonly heavy, and over the rough hummocks we are certain to encounter our only mode of advancing will be by a system of double-banking, which simply means one mile made good for every five actually marched. If we accomplish two miles a-day it will be a fair day's work.

" *April 11th.*—Snow falling. Parr in advance with half a dozen men cutting a road with pickaxes and shovels, the remainder of the men dragging up the sledges singly. Between the hummocks, the snowdrifts are very deep, and we are continually floundering up to our waists, but the men struggle bravely on. The men appear a good deal done up.

" *April 12.*—An unexpected but most gratifying change of temperature caused us to pass a comparatively comfortable night.* Travelling through hummocks is most unsatisfactory work; it is a succession of standing pulls—one, two, three, haul! and very little result. The snow, too, on the floes are very deep, the upper crust of which being frozen, the sledge runners break through and sinking into the soft snow render the dragging very laborious."

Commander Beaumont's account is not more cheering :—

" *April 6th.*—Left ship at 1 P.M. As it was our first night, the men were tired and cold; the ice makes a very cold bed; everybody turned in by 8.30 P.M., but what with the cold and the novelty of things nobody can sleep; the pemmican was so stodgy it was like eating damp sawdust.

" *April 7th.*—Every one very stiff and cramped from the exertion of yesterday and the cold of the night. Temp. — 45°. Pemmican not much liked, though they don't like to own it.

" *April 8th.*—All the men feeling stiff and sore. Leggatt nearly fainted, overworked the first day, has not eaten sufficient food since. The 4 oz. of bacon which we have at lunch is frozen so hard and so intensely cold to the teeth that none can eat it. Much difficulty in making the tea owing to the wind. Rourke fallen down exhausted on the snow. Ther. — 35°.

" *April 9th.*—Ther. — 31°. Heavy hummocks and the prospect of heavy ice.

" *April 10th.*—Men better; confused mass of hummocks presented nothing but points and sharp edges, pickaxes had to clear the way; sledges were unloaded so as to lower both sledges and crews down on to the floe, 20 feet below.

" *April 11th.*—We were all so tired last night that, for the first time out, we slept soundly.

* It may be inferred from this that the nights since starting had been wretched, and comparatively sleepless.

"*April 12th.*—Ther. -21° . Constant strain on the eyes in trying to distinguish "the good leads; not able to see without pain."

The Western sledging party under Lieutenant Aldrich left the "Alert" on the same day as Captain Markham's party, and was subject to similar privations:—

On the 11th April—eight days after starting—the following entry occurs in Lieut. Aldrich's Journal:—"Every one has eaten a full pannican of pemmican to-night for the "first time, their appetites having failed them for eight days." The same low temperature, sleeplessness and discomfort to which Captain Markham's men were subjected, were experienced and suffered by this party likewise.

By this it will be seen that the work which these sledge parties underwent was excessive and out of proportion to the exercise they had taken during the winter months; compared with which, the winter months may be termed a period of comparative inaction.

Every one of the sledge parties tells of the very great amount of fatigue he underwent. It was not simply the work of dragging the sledge: to have dragged a load which averaged more than 200 lbs. for each man over smooth ice and hard snow, would have proved a labour of itself, but to drag this weight over the rough ice, and the hummocks and snow they encountered, increased the work and made it one of distress.

One of the captains of the sledges, a petty officer, describes this work as the hardest he had ever endured: "The snow," he says, "was that deep that you sank "right down through it, and you had to pull your leg out of the same hole again, and "to take the next step in a similar way; and the sledge would bury itself into it, and "the snow drifted here and there, heaving it up into hillocks; you had to drag your "sledge over it, or cut through it by means of pickaxe and shovel (7821)." These hummocks varied from 10 to 15 feet in height, and it took two or three hours to cut a road over them (7824, 7827).

Other distressing circumstances were in operation towards lowering the physical energies of the men; many suffered from thirst, but being warned against eating snow, they preferred to endure this inconvenience; while the perspiration caused by the forced work, and which froze upon them on encamping or on standing still for any time, and which the heat of their bodies was not always able to thaw, was another source of discomfort. "The perspiration found its way through the drawers into the lining of "the trousers, and the flaps of the duffle trousers were frozen so hard in consequence "of the moisture, that we were unable for some days to button them" (717).

The excessive cold and fatigue combined took away their appetite, and prevented them from enjoying that amount of sleep which, in their circumstances, was an absolute necessity; in spite of the great fatigue which their work entailed, they "preferred work "to lying in their cold sleeping bags" (746).

In the enumeration of these causes we have many depressing influences at work at the same time in men who had passed a winter under adverse circumstances, and who consequently were not "in the same vigorous condition that they would have presented "after a season spent under more genial circumstances."

It is important that these circumstances should be taken into consideration before forming an opinion as to the sufficiency of the diet consumed by the men during the sledging expeditions; for it is necessary that a proper relation should be maintained between the amount of work and the dietary, and this relationship is subject to modification according to the quality and variety of the food, to the activity or completeness of the process of nutrition, and to the conditions, other than work, to which the individual subsisting on the dietary is subjected.

The examination by the Committee of the chief foods contained in the sledge dietary has already been stated to have shown that their quality is undoubtedly good (also Appendix, No. 23). Variety was necessarily curtailed by the exigencies of sledging, but it was to some extent obtained by the presence of both pemmican and bacon, and of two descriptions of the former on the diet list.

On the other hand, the evidence and sledge journals appear to show that the fatigue and exposure undergone, and to some extent the novelty of the food, diminished appetite, at any rate during the earlier days of travelling (729, 961, and extracts from Journals quoted above).

Further, it is a well ascertained fact in dietetics that exposure to great cold modifies the food requirements of individuals. During the performance of a given amount of work, a much larger quantity of food is required in very cold than in temperate or warm climates, the difference being used in maintaining the temperature of the body at its normal point. In order that this may be accomplished in the presence

of great cold, it is probable, not only that the quantity of food properly assimilated and used in the system should be large, but also that fats and perhaps carbohydrates should be largely present in the food. It is further probable that during considerable physical labour in the presence of great cold, health may be maintained either by a dietary in which the total quantity of food is very large, without any remarkable increase in the proportional amount of fat; or by one in which the total quantity of food, though large, is not very remarkably so, but in which the fats are represented in much greater quantity than in ordinary or standard diets.

The following table, extracted from the evidence, permits of a contrast being made between the ship and sledging dietaries in respect to their more important nutritive constituents (4999, 5000):—

SHIP DIET.

Constituents.	oz. water-free.	Ratios : albuminates = 1.
Albuminates ..	4.76	1.00
Fats ..	4.18	0.88
Carbohydrates ..	16.84	3.54
Salts (mineral) ..	1.66	0.35
Total ..	27.44	

SLEDGE DIET.

Constituents.	oz. water-free.	Ratios : albuminates = 1.
Albuminates ..	7.99	1.00
Fats ..	11.65	1.43
Carbohydrates ..	15.22	1.90
Salts (mineral) ..	0.79	0.10
Total ..	35.65	

The quantity of nitrogenous material (albuminates) is large in the sledge diet, and the fats, while in more than ordinary amount in both, are in considerable excess in the diet scheme of the sledge parties. Whether this excess of fat, taken in conjunction with the somewhat large total quantity of nutritive material renders this dietary a sufficient one for men engaged in severe physical work in extreme cold may best be decided by experience; but it would appear that in previous arctic expeditions, such as those of Sir Leopold M'Clintock, a dietary essentially the same succeeded in maintaining health in a generally satisfactory state, in the presence of severe cold and considerable physical exertion.

In these previous expeditions, the cold experienced did not differ very materially from that experienced by the recent expedition (3100, 3242, 3685, 4648), but judging from published narratives and the evidence laid before the Committee, the physical exertions undergone by the men were greater in the recent expedition, or at any rate in the chief sledging journeys of this expedition, than on any previous occasion.

In the case of two of these journeys, estimates have been made of the work done, according to the method usually adopted; and it would appear that in the Northern extended sledge journey the average work done daily per man was equivalent to 534 foot-tons, and on the Western extended sledge journey to 432 foot-tons (Appendix No. 24). It has already been stated that the productive work which can be done on the sledge diet has been estimated at 585 foot-tons. The work done in these two expeditions was not therefore greatly below the calculated productive value of the food, provided this food were all consumed and used in the system to the best advantage. The evidence, however, shows that for several days the men were unable to take their full rations. It is probable also that the extreme cold to which the men were subjected would absorb a greater proportion of the total potential energy of the food in maintaining a normal temperature than has been allowed for, and would thereby reduce the amount available for productive work below 585 foot-tons. It is further probable that the physical work has been under-estimated, so exceptional were the difficulties encountered by the men.*

The conditions of the Eastern sledge journey seem to have been similar to those of the Western.

* The embarrassment caused by these difficulties is in a measure illustrated by the remarks made by Captain Markham on Dr. De Chaumont's corrected estimate of the work done by the Northern sledge party (Appendix No. 24). The mean work done by each man has been estimated at 534 foot-tons, and the productive value of the food at about 450 foot-tons, during the time at any rate when the full allowance of pemmican was not eaten. Captain Markham considers the former estimate an erroneous one, and gives in his remarks a number of reasons in support of this view. He, however, proceeds to state that "the coefficient of resistance for the sledges is in all probability nearly correct, but I consider the coefficient of resistance for the men marching to be infinitely greater than that of the sledges." If the estimate of the work done be modified in accordance with this statement, even although at the same time the other corrections are taken into account, it will be found that the mean is raised much above Dr. De Chaumont's estimate. Indeed, if the coefficient of resistance for the men marching be merely increased to that for the sledges, and not above it, the mean work done would appear twice as great as the highest estimate, or about 1000 foot-tons per man daily.

Commander Aldrich has made a statement on this point also indicating that the coefficient of resistance

The three chief sledge parties were, therefore, subjected to arduous labour in extreme cold, and, for several days at any rate, to deprivation of sleep and insufficient nourishment.

It appears from the evidence before the Committee, that of the total number of cases of scurvy connected with the recent expedition, the majority occurred among the men employed in these three extended sledge journeys. In two of the extended journeys—the Northern and the Western—the men engaged belonged to the crew of the “Alert,” and in the third—the Eastern—to the crew of the “Discovery.”

The Northern sledge party consisted of two officers and fifteen men, and all were affected with scurvy during the journey. The Western sledge party consisted of two officers and fourteen men, half of whom were attached to a supporting sledge, which left the main sledge twenty-two days after the start from the “Alert”; seven men of the main sledge were affected during the journey, and six men of the supporting sledge in this or in subsequent journeys. Thirty cases, therefore, out of the forty that occurred among the “Alert’s” men during the sledging season, were connected with the two main sledge journeys made from that ship, while several other cases occurred in men who were employed in the three supporting sledges attached to the Northern party.

The Eastern sledge expedition was composed of one main sledge and of three supporting sledges, which left the main sledge at different points during the journey, and it comprised a party of three officers and twenty-one men. They all belonged to the crew of the “Discovery”; but one officer and seven men had wintered on board the “Alert,” the remaining sixteen having wintered on board their own ship. The one officer and seven men of the main sledge of this expedition all became affected with scurvy; and one officer and eight men belonging to the three supporting sledges also became affected, but not in every instance while employed on this expedition.

Seventeen cases, therefore, occurred among the twenty-four men who were connected with this expedition, and they certainly constitute a striking proportion of the nineteen cases which occurred among the crew of the “Discovery” who engaged in sledging.*

Connected with this Eastern sledge expedition there is an interesting and probably an instructive circumstance, which has a material bearing on the opinion, suggested by the history of the outbreak of scurvy, and given expression to in the evidence, that the “Discovery’s” men enjoyed an immunity from this disease as contrasted with the “Alert’s” men, and that this immunity may be ascribed to some condition tending to protect against scurvy that existed during the winter on board the “Discovery” and not on board the “Alert.”

All the men engaged in the Eastern expedition belonged to the crew of the “Discovery,” but sixteen of them had wintered in that ship, and eight in the “Alert.” The main sledge party all suffered from scurvy, although seven of them had wintered in the “Discovery,” and only one in the “Alert.” Of the remaining sixteen men employed with the supporting sledges, nine had wintered in the “Discovery” and seven in the “Alert.” Nine of these sixteen men became affected with scurvy at some time during the sledging season, and five of the nine had wintered in the “Discovery,” and the remaining four in the “Alert.”

It would appear, therefore, that seventeen men out of the twenty-four engaged in this expedition, or 70·83 *per cent.*, became scorbutic, at some time within the sledging season. Of these seventeen cases of scurvy, twelve occurred among the sixteen men who had wintered in the “Discovery,” or 75 *per cent.*, and five among the eight men who had wintered in the “Alert,” or only 62 *per cent.*

These facts show that much weight cannot be given to the supposition that any conditions existing during the winter on board the “Discovery” specially tended, as contrasted with conditions on board the “Alert,” to confer protection against scorbutic disease. When men who had been exposed to these supposed to be favourable conditions were called upon to endure hardships and severe physical labour, and to

for the men marching should be greater than Dr. De Chaumont has assumed it to be; and if the calculations be modified in accordance with that statement, the mean work per diem for each man in his sledge party (the Western) will be raised much above 432 foot-tons.

In connection with these estimates a misapprehension appears to exist regarding the use of the expression “mean weight dragged per man.” By this expression, it is obvious that Dr. De Chaumont does not imply the weight dragged at any one time, but the mean weight advanced by dragging in the day by each man.

* There appears to have been twenty cases of scurvy altogether among the “Discovery’s” men, leaving only other three to be accounted for. One of the three was the case of the ship’s steward, described at p. x; the other two occurred in men who had been engaged in comparatively short expeditions, during which, however, they subsisted on the same dietary as the men of the extended sledge parties.

subsist on the diet of the sledge parties, they became affected with scurvy in even greater numbers than men who had been deprived of these supposed to be favourable conditions, but who endured along with them similar and even the same hardships and severe physical labour, and subsisted on the same diet.

Several of the less important sledge parties suffered privations and encountered obstacles to some extent similar to those of the extended and chief expeditions; but as their journeys were less prolonged, the men who took part in them were not subjected for so long a time to these unfavourable conditions.

Yet although scurvy be "a species of starvation, it differs from ordinary inanition "from want of food" (5249). "The want of food generally, in some conditions, "may happen without scurvy" (4891); "and a dietary deficient only in quantity . . . "might issue in starvation, in consumption, or other wasting malady, it would not "bring on scurvy" (5358). It may likewise be affirmed from the evidence that, so far as our knowledge goes, privation, fatigue, and exposure to extreme cold are not themselves capable of producing the disease (4994, 5191, 9349-9354), however much they may favour its development.

The appearance of the disease during the sledge journeys of the recent expedition cannot be accounted for by any of these conditions; and even although it be a disease of mal-nutrition, insufficient nourishment cannot be regarded as the main cause of its production.

Besides the differences now considered between the ship and sledge dietaries, another, however, existed, which was of great importance. The ship dietary provides for a liberal allowance of vegetable food. Preserved vegetables, including potatoes, were issued on board in rations of 8 ounces once or twice a-week, and of 4 ounces four times a-week; compressed vegetables in rations of 1 ounce once or twice a-week; and pippins or bottled fruits in rations of 2 or 6 ounces, respectively, twice a-week; while vegetables were present in several of the tinned meats regularly consumed. There was besides a daily ration of 1 ounce of lime juice, which was increased to 2 ounces on board the "Alert" during the month of March.—(Appendix, Nos. 3 and 10.)

In the sledge dietary, however, the vegetable element, as it has been termed, is represented by only 2 ounces of preserved potato; and the evidence shows that this quantity is an insufficient one. Thus, Dr. Macdonald states, "two ounces of potatoes "would not be enough to my mind" (4907); Dr. De Chaumont, when asked if this quantity is insufficient to ward off scurvy, replied, "I think it was" (5004); Dr. Guy expressed the opinion "that the potato element is decidedly defective" (5339); Dr. Buzzard, that "the item 2 ounces of potato is evidently exceedingly inadequate" (5484); and Dr. Barnes said, "I see only 2 ounces of potatoes was the ration for the sledging parties; that certainly appears to be insufficient" (7045). Evidence to the same effect was tendered by Dr. Pavy (5216), Mr. Busk (5249), Mr. Leach (5597), Dr. Dickson (5622), and others.

A small quantity of onion powder and curry paste ($\frac{1}{8}$ th ounce of each) was also contained in this dietary; but the bread baked on board ship five times a-week was necessarily exchanged for biscuit.

The contrast between the two dietaries in respect to the vegetable, or antiscorbutic, element is further increased by the absence of lime juice from the sledge dietary. This omission must be held accountable for the serious outbreak of scurvy during the sledging season. The evidence and the history of the outbreak point distinctly to this conclusion. Even although there were many conditions favourable to the development of scurvy among those operating upon the sledge parties, none of them can be regarded as necessary antecedents to the disease. The absence or deficiency of the vegetable element in the diet is the only known invariable antecedent;* and lime juice on account of its well established property of supplementing such a deficiency, may confidently be considered an adequate preventive against scurvy. Its reputation, established many years ago, has not been injured, but rather confirmed, by the history of the recent expedition, and by the evidence laid before the Committee. Fifty-eight cases of scurvy out of the sixty in this expedition occurred in men who for longer or shorter periods had been deprived of this antiscorbutic, and, who on account of the exigencies of sledge travelling, had

* This proposition is not disproved by the rare occurrence of scurvy while fresh vegetables of undoubted antiscorbutic power, or even lime juice, is being consumed. It is not sufficient that the vegetable or lime juice be merely swallowed, but the function served by those substances during the process of nutrition must be accomplished. In these exceptional cases, it will generally be found that on account of existing disease, alcoholic indulgence or some other cause, the process of nutrition was not properly performed; and it may legitimately be inferred that the vegetable antiscorbutic or food was not able to exert its ordinary influence upon that process.

been necessarily also deprived of the vegetable food for which it serves as a convenient substitute. At the same time, these men had not been subjected to any other condition that is known to cause scurvy, nor, indeed, had they all been brought equally under the influence of conditions indirectly favourable to the development of this disease.

Although lime juice was not represented in the sledge dietary, it was carried and used by some of the minor sledge parties, and especially by those which started from the ships towards the latter part of the sledging season or visited the depôts where lime juice was stored. The sledge parties which suffered most severely from scurvy were not provided with it.

That the disease appeared in some of the sledge parties at an unusually early period after the first operation of the *vera causa* is no doubt due to the influence of the several conditions prejudicial to health which existed in their most intense degree among the men who composed these parties. These conditions all tended to impair nutrition, but that this impairment should have assumed the character of scorbutic disease was manifestly the effect of the *vera causa*. Nor is this circumstance so remarkable as it might otherwise appear to be when the nature of the conditions and their influence upon nutrition are taken into account. The men had for several months been subjected to comparative inaction on board ship and to the influence there of many causes known to be unfavourable to healthy nutrition; they were then, without any preparation that can be regarded as adequate, placed in circumstances necessarily demanding a most active performance of the function of nutrition, while the nature of these circumstances alone rendered such nutrition difficult, if not impossible. Coincidentally with these changed circumstances, they were deprived of a diet which contained, in quantity sufficient at any rate for ordinary circumstances, that kind of food shown by experience to be the most serviceable in preventing scurvy, and in its place received a diet in which this food was undoubtedly deficient.

II. CASES OF IMMUNITY FROM SCURVY.

The instances of immunity from scurvy which have been recorded in evidence among sledging parties, whose journeys extended over several weeks, and in some instances over several months, seem, *prima facie*, to have injured the value of the authoritative precedents which the history of scurvy has established.

The evidence, however, upon the subject of this immunity is not conclusive. Some of the witnesses attributed it to the physical condition of the men before starting—a condition which they believed was due to the hygienic precautions observed during the winter months,—and likewise to the special conditions existing during sledging. Others again were of opinion that the amount of meat consumed by these sledge parties was a sufficient cause for the immunity they enjoyed; that the pemmican in some way supplied the element which the system demanded, and proved the means of better fortifying the constitution against the disease.

Though the work, to which these sledge parties were subjected, was often hard, it was apparently not sufficiently so to develop the disease during the time in which the *vera causa*, if existing, was in operation.

With the present information there is not sufficient evidence to appreciate the importance of these exceptional and isolated instances, and something more conclusive is required before a decided opinion can be offered regarding them.

Whenever any immunity was enjoyed by the officers over the men of the same ship, there was convincing proof in evidence that the food of the former was more varied and in greater abundance, and the operation of the predisposing causes less continuous or powerful. Whenever it happened that the diet and the conditions were the same for both officers and men, scurvy made no difference, but attacked them equally.

In the recent expedition only 5 officers, out of the total of 26, appear to have suffered from scurvy, whereas 55 men out of 96 suffered. The explanation of this immunity may be found in the circumstances that have been referred to. The officers subsisted on a more varied diet than the men while on board the ships, and this variety, besides, was to some extent constituted by the use of several substances, and notably of milk, wine and preserved fruits, which are probably themselves antiscorbutic (41, 284, 985). When employed in sledge journeys, the officers no doubt subsisted on the same diet as the men; but the other conditions to which they were subjected were not usually in all respects the same as those to which the men were subjected. One of those conditions, and probably one of the most potent in developing the disease in the recent expedition, was severe physical labour; and the evidence shows that the officers were not subjected to this condition in an equal degree with the men, nor, indeed, would it have been compatible with their special duties that they should have been (1452, 2973, also "Report of Proceedings," by Captain Nares, Arctic Expedition, 1875-6 (C.—1636), p. 27).

In considering this question of immunity, it is necessary to bear in mind that, although a deficiency or entire absence of fresh vegetable food, of what is frequently termed a succulent character, is an invariable antecedent of scurvy, it does not follow that the disease invariably occurs during this deficiency or absence. Time and accessory antecedents are important elements in the production of the disease; and while it may appear with startling rapidity after the necessary antecedent, or *vera causa*, has come into operation, provided the accessory antecedents are of the kind and present in the intensity required to favour sufficiently the operation of the *vera causa*, it may be delayed greatly, or may altogether fail to appear, even although the *vera causa* be in operation, provided such accessory antecedents as exist are neither of the kind nor present in the intensity required for the early development of the disease, or for its development before the operation of the *vera causa* has come to an end.

3. SUGGESTIONS IN REGARD TO THE PREVENTION AND TREATMENT OF SCURVY, AND THE USE OF LIME JUICE AND OTHER ANTISCORBUTICS.

Prevention of Scurvy.—Although it may sound as a truism unnecessary to be enunciated, the most important consideration in the prevention of scurvy is the maintenance of health at a standard as near the normal as possible. This necessarily implies the avoidance of all causes tending to impair the nutrition of the body; but as the subject of this paper is a special disease of nutrition which occurred in connection with the recent Arctic Expedition, the discussion of such causes may be limited within convenient bounds.

In arctic exploration, as at present pursued, men are exposed to two groups of conditions; the first (*a*) being associated with life on board ship, and the second (*b*) with life when travelling on land or on ice. The chief of the conditions likely to deteriorate health included in each of the two groups, have been referred to in a previous part of the paper. What measures may be taken to avoid or mitigate their injurious effects will now be considered.

(*a.*) Insufficient exercise and personal filth both tend to impair nutrition and thereby to favour the development of scurvy, and the greatest care should be taken to prevent their existing. The prolonged absence of the sun's rays has a deteriorating influence upon the constitution.

The breathing of an impure atmosphere and exposure to dampness are evils which to some extent are inseparable from life on board ship in arctic regions. They both depend on imperfect ventilation; while the great coldness of the external air, which presents a formidable obstacle to the sufficiently frequent renewal of the air between decks, and the limited accommodation at the disposal of the crew, which increases the necessity for frequent renewal, render it difficult to obtain satisfactory ventilation. The former cause of difficulty will probably be found less formidable to encounter than the latter, and a means of successfully doing so is suggested in the evidence (1651, 5034, 5035, 5408, 5076). This is by the adoption of a plan of ventilation frequently employed in dwelling-houses, and exemplified in Galton's ventilating fire-place, which provides for the heating to a convenient temperature of fresh air admitted from the outside, before distributing it throughout the dwelling. By this method, not only might the air of the lower deck of ships be more frequently renewed, but at the same time the warming of the living and sleeping compartments would be effected, and probably without any remarkable increase in the quantity of fuel usually expended for the latter purpose. The adoption of this method would likewise result in lessening dampness and condensation between decks; as warm air is capable of retaining in suspension a much larger quantity of watery vapour, and of being more frequently renewed, than cold air. An adequate accommodation for the crew, considerably above that provided for the men of the recent expedition (p. ix), would not only be in itself beneficial, but would also diminish the difficulty of satisfactory ventilation.

The scheme of diet used on board by the recent expedition has met with general approval. Several suggestions have, however, been made with a view to its improvement, and some of these may now be adverted to. These suggestions chiefly relate to the introduction into the dietary of articles not there represented, or to the substitution of various articles for others represented in that scheme.

Among the former, is the suggestion that eggs should be carried and used as freely as possibly on board (700-708, 4127, 4195, 5476). It may be assumed that this addition to the dietary would aid greatly in supplementing any deficiency that may occur in the supply of fresh meat. The reasonableness of this assumption rests on the facts that a single common egg contains the full nutriment of two ounces of fresh beef and four eggs, therefore, of half a pound, and that by the use of milk of lime, or othe

preservative substances, eggs may be kept perfectly for many months without increasing their bulk in package. In arctic service, the difficulty of preservation would be only slight, as in a short time the eggs would be conveyed to a cold climate, in which the further use of any preservative substance would be unnecessary. The chief inconvenience resulting from milk of lime is that it makes the shells extremely brittle; but if this inconvenience be a serious objection, it may be avoided by the use of oil, or butter, or collodion dissolved in ether, in place of milk of lime, or by preserving the eggs by merely dipping them for a few seconds in boiling water, or by pouring boiling vinegar over hard boiled eggs after the shells have been removed (4198).

Milk, also, on account of its well known nutritive value, might be more largely used as an ordinary ration, in the form of condensed milk (655, 2102, 2432, 2710, 4253, 5194, 5477, 5718). It frequently constitutes the sole article of food during many months,* without scurvy appearing, and hence it has acquired a reputation as an antiscorbutic (5249, 7077), which, however, is not altogether beyond suspicion† (5162).

It is quite obvious from the evidence and from the well-known nutritive value of fresh meat—a value which renders it specially adapted as a food for cold climates, apart from any influence it may be able to exert in warding off scorbutic disease—that it should form as large a proportion as possible of the meat diet. The application of this principle, however, is unfortunately beyond control, for it is limited by the circumstance that a sufficient supply is not always attainable owing to the scarcity of animal life in northern latitudes. In future expeditions, the supply may possibly be made independent of this circumstance, by fresh meat being carried in sufficient quantity, and preserved untainted until winter quarters are reached, by some method similar to that which within the last few months has been so successfully adopted in this country and in America.‡ Preserved and tinned meats may, however, be obtained of excellent quality. They are capable to a great extent of taking the place of fresh meat in dietaries well provided with vegetable substances. The chief objection that can certainly be urged against their use is that they are somewhat insipid, and on that account likely to become distasteful; but this objection may be greatly obviated by the plan adopted in the recent expedition of alternating the use of the several kinds as far as possible, and so obtaining variety, and of rendering them more palatable by the use of pickles and condiments. With the same object, salt meat may occasionally be used, care being taken that it is not oversalted, for in that case an unnecessarily large portion of the constituents soluble in water is removed with the brine and the water used in repeated soakings. At the same time the evidence seems to show that a prejudice exists with sailors against the use of salt meat (7204, 7888, 8189, 8190, 8382, 9303). An explanation of this prejudice may probably be found in the dread still lingering in their minds that, apart from any question of its nutritiousness, salt meat is peculiarly a cause of scurvy (7680, 8461).

Cheese, butter, and oatmeal would all prove valuable additions, and may with advantage be taken into consideration in the framing of any future scheme of diet.

However well adapted a dietary may be to supply sufficient nourishment, it cannot be regarded as a satisfactory one unless vegetable food be largely represented in it. The functions of nutrition otherwise become perverted, and scorbutic disease manifests itself. It is impossible to attach too great importance to this point.

The vegetables should as far as possible be of a succulent character, and, if preserved, but little changed in chemical composition. Tinned vegetables, such as were used on board the ships of the recent expedition, seem to be efficient representatives of fresh vegetables, as their chemical composition is essentially the same after as before preservation.§ Compressed vegetables, however, are not so trustworthy,¶ and they should not constitute the main representatives of this class of food in the form in which they are now met with, although their occasional use may be attended with the advantage undoubtedly derivable from variety. Among vegetable foods, the potato at present occupies the highest place as a valuable component of dietaries. It affords much nutriment, and, further, it tends so to influence the process of nutrition that the special impairment of that process which renders itself obvious in the production of scorbutic symptoms is prevented, provided a sufficient, but by no means large, quantity be taken. The chemical examination of the preserved potato used in the recent expedition (Edwards's) shows that it retains all the chief

* In Caille's "Account of a Residence among some African Tribes," the natives are represented as subsisting almost altogether upon milk.

† Dr. Parkes. The British and Foreign Medico-Chirurgical Review, October, 1848, p. 442.

‡ Sheep were taken from England in H.M.S. "Assistance" (Austin's Expedition, 1850–51), and were killed when the ship reached a high latitude. The mutton was wrapped in matting and hung in the rigging, and it kept well for fourteen months; but it was necessary to thaw it gradually before cooking, as otherwise it became tainted.

§ Dr. Attfield's Report, p. xlii.

¶ Ditto, p. xlix.

constituents of the fresh potato in natural proportion.* It is also agreeable and palatable, and is a conveniently condensed preparation, one part being equivalent to about three-and-a-half parts of fresh potato. The quantity which appears to have been used on board the ships (four ounces four times a-week; 8892, 8919) may be considered a sufficient one, seeing that other vegetables were also used. Advantage would however be derived from a daily in place of an interrupted issue, and this could be effected by adding a ration of two ounces of potatoes to the vegetables issued on the days when potatoes are not issued.

Many fruits, and particularly those of an acescent nature, share with succulent vegetables the valuable property of preventing the scorbutic perversion of nutrition. Accordingly, it may be advisable to provide for the liberal use of such fruits, whether bottled, or preserved dry, or converted into jams or pickles.

The dietetic use of alcohol may be referred to under this subdivision of our subject. It is a significant fact in the history of the recent expedition that the first two cases of scurvy occurred in men who were addicted to an immoderate use of alcohol, and who had not been exposed to the deteriorating conditions that existed during sledge travelling. In the former respect, these men were apparently exceptions in a crew selected because they "were men of very good character, who could scarcely ever have committed themselves in their long previous career in the Navy" (115). It appears also that in former arctic expeditions, scurvy has occurred in men who indulged in alcohol to excess, while at the same time the disease was not prevalent among the rest of the crew (3500). From the nature of the injurious action on nutrition of alcohol taken in immoderate quantity, it may be assumed that when so used it becomes a powerful predisposing cause of scurvy. There is, however, no conclusive evidence of its materially aiding the development of scurvy when used in moderation. At the same time, it is a remarkable fact that the men employed in the Hudson's Bay Company's service, who rarely drink alcohol in any form, enjoy almost complete immunity from this disease, notwithstanding prolonged exposure to an arctic climate, and fatiguing sledge journeys, which on some occasions have lasted for several months (8701-8875, 6144, 6159). Alcohol was used on board the ships of the recent expedition in the form of rum, and usually in rations of half-a-gill of this spirit. This ration is probably incapable of causing injury to healthy men previously accustomed to the regular use of alcohol. A ration of one gill (5 oz.) of rum, however, continued for several months, in the conditions existing during the winter, would be likely to affect nutrition injuriously, and thereby to become an accessory cause of scurvy. If it be advisable, in the presence of conditions tending to produce mental depression, to use alcohol in arctic service during a period of comparative inaction, the ration should be a very moderate one, and probably not larger than half-a-gill of rum. Advantage would be derived from the substitution of wine, and especially of subacid wines, for spirit of any kind (655, 2102, 2929). Encouragement should also be given to the use of malt liquors in preference to rum or other spirit (655).

These suggestions all tend to favour the one main object of maintaining health at a standard as near the normal as possible, and of thereby ensuring a proper performance of the functions of nutrition. So long as this object is successfully accomplished, it may confidently be anticipated that scurvy will not occur.

If, however, conditions prejudicial to health are permitted to exist, their operation will produce a deterioration of health favourable to the production of scurvy, and that in a degree varying with the kind and intensity of the deteriorating influences. It may, therefore, become necessary, or at any rate advisable, to adopt measures, otherwise superfluous, to oppose these deteriorating conditions; and where experience has shown that their existence specially favours the production of scorbutic disease, the measures adopted should naturally be of the kind most likely to prevent this disease. The chief of these is a modification in the dietary involving an increase of the vegetable element. Vegetable foods, however, contain many substances that are not peculiarly antiscorbutic, and their increase might lead to an inconvenient addition in the quantity of the food. Hence it is that in these circumstances preference is given to vegetable substances that are more *antiscorbutic* than *nutritious*, the chief of which is the juice of the lime or lemon.

As a preventive of scurvy, lime or lemon juice is generally used in Merchant Ships and in the Navy during Polar Service in a ration of one ounce daily, and it is found effectual in this quantity, even during the existence of many conditions favourable to the

* Dr. Attfield's Report, p. xlvii; also Dr. De Chaumont's Analysis, Appendix No. 23.

development of the disease. The presence of a large amount of free acid in this juice endows it with the special action of an acid which is distinct from that it possesses as an antiscorbutic. If too large a quantity be given for a long time, the former action may become injurious by impairing digestion and diminishing appetite; and although in certain circumstances this injury may be counterbalanced by the prevention of otherwise inevitable scorbutic disease, still care should be taken not to increase the ration above that required for this purpose. The necessity for an increase above the usual ration of one ounce will occur when some condition obviously tending to produce scurvy is found to exist, or when by careful observation symptoms suggestive of a scorbutic taint are first detected.

Some further reference will be made to lime juice as well as to other reputed antiscorbutics in a subsequent portion of this paper.

(b.) The experience of the recent expedition has shown in a very conspicuous manner that fatigue resulting from severe muscular exertion (3169, 3188), especially when undergone after a period of comparative inaction (153, 2980), is one of the main accessory conditions favourable to the development of scorbutic malnutrition. It is, therefore, important to avoid this condition as far as possible; by lessening the weight to be advanced, by refraining from severe labour during the first few days of the journey, and by adopting sledges of such a construction that they may be as well adapted for being dragged over the kind of road encountered as the circumstances will permit (952, 1303, 8729). It is also of much importance to avoid any abrupt change of diet, especially when severe labour is at the same time suddenly undertaken; and this may to some extent be done by accustoming the travellers before their start to any unusual articles of food contained in the sledge diet.

Unless these precautions be observed great risk is incurred of impaired digestion and nutrition, which may precipitate the occurrence of scorbutic malnutrition should the diet unfortunately be defective in the required direction.

The work of sledging being attended, even in the best of circumstances, with severe muscular exertion, the quantity of food represented in the scale of diet should be large, and non-nutritious substances should be eliminated from it to as great an extent as possible. The latter object is successfully attained by the use of condensed foods, such as pemmican and dry preserved potato. Pemmican is a nutritious food well adapted from its composition* for severe work in a cold climate. The experience of the recent expedition showed, however, that some men did not at first care for this food (338, 592, 961, 1303); but this distaste appears to have disappeared greatly on further trial (729, 961). It would be advisable to provide for such exceptional cases, and at the same time introduce variety, by having other meats at the command of sledgers, such as dried beef or venison, tinned meats, or bacon, many of which might be advantageously stored in depôts. In the more northern latitudes, sledge parties cannot hope to supplement their supplies to any material extent with game, but the great value of fresh meat to sledgers will always render it desirable that no opportunity be lost of securing game whenever it is met with.

For reasons previously stated, the addition of milk to the dietary would prove valuable, in the form either of condensed or of desiccated milk (836, 4190, 3664-3671), the latter being even a more concentrated food than the former.

A diversity of opinion has been expressed in the evidence with regard to the use of alcohol during sledging. On the one side it is stated to be injurious (4686, 5249, 8808), while on the other it is stated to serve many useful purposes. The chief of the latter are the removal of wakefulness resulting from exhaustion (5204, 5415), and the production of a feeling of comfort and a disposition to undertake further labour towards the end of a day's work (503, 667, 6778-6782). The evidence is decidedly opposed to its possessing any power of increasing the amount of work above what may be done without its use; while the opinion has even been expressed that in place of increasing it really diminishes the capacity for work (4865, 5204, 5249, 5964, 9012). Apart from any question of its influence upon nutrition or health, there does not appear to be any marked advantage derivable from its use, although previous habit or custom may be regarded as a reasonable ground for its continuance in small quantity; and it is probable that nutrition or health cannot be materially affected by so small a daily ration as half-a-gill of rum, at least in selected men undergoing severe but not excessive outdoor labour in a cold climate. The experience of sledge travellers does not afford any decided evidence either of its power to prevent or to cause scurvy. Long sledge journeys have been accomplished by men supplied with rations of rum without scurvy having obviously appeared (3008, 3119, 5753), and

* See Professor Frankland's Analysis, p. xlv.; and Professor De Chaumont's Analysis, Appendix, No. 23.

equally long journeys by men who abstained from its use and who likewise enjoyed an immunity from this disease (8807). There can be no doubt, however, that the dietetic use of alcohol should be interdicted in men suffering from any symptoms of scurvy; and wherever its deprivation is not opposed to custom or acquired habit it would be advisable to refrain from its use as a regular ration, in the usual conditions of arctic sledge travelling.

The substitution of tea for alcohol in sledge travelling is attended with much benefit, and there is in the evidence a general expression of approval of that carried by the sledge parties of the recent expedition in the form of compressed tea. It is shown by the report of the chemical examination of this tea made by direction of the Committee, that there are sufficient grounds for this approval.* One of the chief advantages of compressed tea is its compact form, which renders it convenient for carriage and for distribution in stated rations. This advantage, with the addition of others, may be derived from the use of a carefully prepared extract of tea, such as Dr. Rae carried in his exploring journey along the west coast of Boothia Felix (8747). It is a much more condensed substance than compressed tea, while with it a cup of tea may be made "with less than half the consumption of fuel, and in less than half the usual time, because we merely have to heat water sufficiently to be pleasant to drink, whereas in making tea in the ordinary way" (*i.e.* with ordinary or with compressed tea) "the great difficulty is to bring the water to the boiling point, especially in very cold weather" (8747). The advantage gained in the time occupied in preparing the ration of tea, apart from the advantage of the lessened weight both of fuel and tea, is of the greatest importance, as the men are exposed to severe cold while waiting for their ration of tea, the preparation of which with boiling water and compressed tea is stated to have occupied so long a time as from an hour and a-quarter to an hour and a half (1296). Tea is always to be preferred to alcohol for the midday meal; but it may be advisable to point out that its well marked action in producing wakefulness is not favourable to its use shortly before the time for sleeping. Alcohol need not, however, on this account be used in its place at the end of the day's labours, for the advantages of tea may to a great extent be derived, without the risks inseparable from alcohol, by the use of beef tea. The invigorating properties of this beverage would render it a valuable addition to sledge dietaries. It may be conveniently carried in the form of extract of beef, or of condensed soup; while the large quantity of salts of organic acids entering into its composition favours the supposition that it may act not only as a refreshing and invigorating, but also as an antiscorbutic article of diet.

Whatever care, however, may be taken to lessen the labour of sledge travelling, to obviate the injurious effects of exposure to an unfavourable climate, and even to supply a sufficient amount of nutriment, scorbutic malnutrition will inevitably occur in a shorter or longer time, if the kind of food requisite for the prevention of this form of malnutrition be not supplied in adequate quantity. In sledge travelling, as usually conducted, the food required for the travellers is either all carried on the sledge, or partly carried and partly stored in depôts at convenient points of the route. The food has to be provided for the travellers without reliance on any extraneous supplies that may be obtained by their exertions.

Fresh food, whether animal or vegetable, cannot, therefore, be usually taken into account in arranging the scale of diet; and it is accordingly of great importance that among the preserved foods of which the dietary must be almost entirely constituted, there should be a sufficient quantity of those which experience has shown to be valuable in preventing scurvy. Of these foods, the one best adapted for sledge travelling is undoubtedly the preserved potato. In deciding as to what constitutes an adequate quantity of this preparation, it is necessary to consider that the circumstances of sledge travelling greatly limit the variety of the diet, that past experience shows that more than one decidedly antiscorbutic food cannot be carried, and that during sledging many conditions will generally exist that are detrimental to health. At the same time, the mere muscular labour involved demands a liberal supply of food, while in order that this food be properly used in the system, the functions of nutrition must be performed with increased activity. In these circumstances, the liability to malnutrition is great, and any deficiency of the vegetable element must be attended with the risk of scurvy. It is important, therefore, that vegetable food of a proper description should be supplied as liberally as can conveniently be done. If preserved potato be the representative of the vegetable element, it is not probable that more than four ounces could be carried with due regard to the necessity for other and more nutritious foods; but in all likelihood even this somewhat large sledge ration would prove an insufficient

* See Mr. Bell's Analysis, p. xliii.

one in the conditions frequently existing during sledging. In order to supplement it, therefore, lime juice, in many respects a convenient substitute for fresh vegetable food, should be issued in rations of one ounce daily. The difficulties attending the carriage and use of this and other antiscorbutics will be afterwards considered.

Treatment of Scurvy.—The main principle to be followed in the treatment of scurvy is to supply such food as will, in the circumstances of each case, most rapidly restore the functions of nutrition to a normal state. Experience has shown that this may best be done, and usually in a most striking manner, by the administration of certain foods and food-substitutes, which are conveniently grouped under the name of antiscorbutics. Vegetables such as potatoes and many of the cruciferæ, lemons, limes, oranges, and shaddocks, are the most important of this group; but it has also, with good reason, been supposed to include fresh meat and fresh fish.

When the state of the gums prevents the patient from masticating, milk, eggs, soups and broths, calves foot jelly, acid vegetable juices, wine, cyder, beer and the fruits mentioned above, as well as others of a subacid nature, should form the essential part of the treatment; combined with quiet and repose. In the advanced stage of the disease, when the slightest exertion produces fainting, too much precaution cannot be taken to ensure absolute repose and freedom from physical exertion.

Complications must be treated according to their special characters.

Much importance is attached in the evidence to the curative powers of fresh animal food (44, 1090, 1100, 2184, 2974). Among the many opinions that have been expressed on this point, none are more decided than those of Dr. Kane. "Our sick are sinking for want of fresh food. It is the only specific: I dislike the use of this unphilosophical term; but in our case it is the true one."* The influence of this food in preventing scurvy has already been considered; and although the evidence does not show that when cooked and eaten in ordinary quantity, it is antiscorbutic in the sense of being sufficient of itself to prevent scurvy, there can be little doubt that, in whatever form or quantity it be eaten, it is a most valuable agent in the treatment of scurvy. At the same time, it is open to speculation if the manner of cooking may not greatly modify the curative action of meat. Cooking which either abstracts much of the juice or subjects it to the action of the air at a high temperature—as in the case of a mutton chop—no doubt more completely modifies the chemical composition of meat than cooking which permits of the juice remaining in the meat protected from free exposure to the air—as in the case of a properly boiled leg of mutton. Meat cooked according to the latter type may reasonably be expected to exert a more decided curative action in scurvy than meat cooked according to the former type.

Codliver Oil—a raw animal fat—may be included in this class of food; and it seems to have proved beneficial in the treatment of scurvy in the recent expedition (1992).

The use of such raw vegetables as are contained in salads, beetroot, tomatoes, uncooked potatoes in molasses, and the numerous other representatives of the class of the vegetable antiscorbutics should constitute a part of the treatment, so far as circumstances will allow.

The use of Lime Juice and other Antiscorbutics.—The most valuable agents in the prevention and treatment of scurvy, are various fruits belonging to the family of the *aurantiaceæ*, such as the orange, lemon, and lime. Their value was recognised so long ago as the 16th century, when Solomon Albertus, in 1573, recommended their use, and especially the use of their juice; and subsequent writers have given good reasons for supporting his recommendation.† The benefit that has followed the general adoption of this recommendation may be appreciated from the facts that since lime juice was

* Arctic Explorations in Search of Sir John Franklin, London: 1876, p. 290.

† Sir Richard Hawkins, in his Voyage into the South Sea in the year 1593 (edited by C. R. Drinkwater Bethune, Capt., R.N.; London 1847—Printed for the Hakluyt Society.) mentions an outbreak of scurvy among the crew of his ship, and says: "That which I have seene most fruitfull for this sicknesse, is sower oranges and lemmons." (p. 60.)

And again:

"Coming aboard of our shippes, there was great joy amongst my companie; and many, with the sight of the oranges and lemmons, seemed to recover heart. This is a wonderful secret of the power and wisdom of God, that hath hidden so great and unknowne vertue in this fruit, to be a certaine remedie for this infirmitie." (p. 81.)

In Sir James Lancaster's Voyage to the East Indies in the year 1600, the following passage occurs (p. 61):

"Thus following on our course, the first of August wee came into the height of thirtie degrees south of the line, at which time wee met the south-west wind, to the great comfort of all our people. For, by this time, very many of our men were fallen sicke of the scurvy in all our shippes, and unless it were in the generall's shippe only, the other three were so weake of men that they could hardly handle the sayles. And the reason why the generall's men stood better in healthe than the men of other shippes was this; he brought to sea with him certaine bottles of the juice of lemmons, which he gave to each one

introduced into the Navy in 1795, scurvy, which was formerly the scourge of that service, has gradually decreased, until it has finally become nearly extinct; while the disease is now so rarely encountered in this country, that opportunities are but seldom afforded for the observation of its symptoms or the investigation of its essential characteristics.

Although there is no difference of opinion as to lime juice being the best of all known antiscorbutics, when vegetable food is absent or deficient in quantity, it has not yet been decided upon which of its constituents this valuable property depends. Like other vegetable juices it is a complex substance. It contains citric acid in considerable quantity, a little malic and tartaric acid, sugar, vegetable albumen, mucus, mineral substances, and between 80 and 90 per cent. of water; and there can be no doubt that the antiscorbutic properties of the juice do not reside in all of these substances. It may, for instance, unhesitatingly be asserted that the water, which constitutes by far the greater part of the juice, has no special value in preventing or curing scurvy; but although the probabilities, founded on observation, are in favour of the free acids, and especially the predominating citric acid, being the valuable ingredient, this supposition has not yet been satisfactorily proved.

In the conditions in which lime juice is most commonly employed, it is not a matter of much moment to reduce its weight and bulk by eliminating its useless ingredients. In sledge travelling, however, it becomes important to diminish weight to the greatest possible extent; and it has been stated in evidence that if lime juice and about an equal weight of sugar to mix with it were carried on the sledges, it would "necessitate a reduction of three days provisions out of the forty-two that are generally carried" (171).

The removal of the greater part of the 80 per cent. of water would produce an extract, which may confidently be considered an equally efficient antiscorbutic preparation as the unconcentrated juice. A preparation of this kind was recommended many years ago by Dr. Lind, under the name of "Rob" (5249), but it would be advisable to depart from the procedure he seems to have followed, and effect the concentration at a low temperature. Some experiments, made for one of us by Mr. Gale, of the firm of John Bell and Co., of Oxford-street, show that a convenient extract may be obtained, preserving the special fragrance of the lime juice, and having only one-tenth the weight of the crude

"as long as it would last, three spoonfuls every morning fasting, not suffering them to eate anything after it till noone. This juice worketh much the better if the partie keepe a short dyet, and wholly refraine salt meat, which salt meat and long being at sea is the only cause of the breeding of this disease. By this meanes the generall cured many of his men, and preserved the rest, so that in his shippe (having the double of men that was in the rest of the shippes) he had not so many sicke, nor lost so many men as they did, which was the mercie of God to vs all. While wee stayed heere in this bay, wee had so royall refreshing that all our men recovered their healtie and strength, onely foure or fve excepted. But before our comming in, and in this place, wee lost out of all our shippes one hundred and fve men, and yet wee made account wee were stronger at our departure out of this bay then wee were at our comming out of England, our men were so well inured to the southerne climates."

John Woodall, Master in Chirurgery, in *The Surgeon's Mate*, printed in London, 1617, has the following in his *Treatise upon Scurvy*:

"And further experience teacheth which I have oft found true, that where a disease most raineth, even there God hath appointed the best remedies for the same greefe, if it be His will they should be discovered and vsed; and note for substance, the Lemmons, Limes, Tamarinds, Oringes, and other choyce of good helpes in the Indies which you shall finde there, doe farre exceed any that can be carried thither from England, and yet there is a good quantity of Juice of Lemmons sent in each ship out of England by the great care of the Marchants, and intended onely for the releefe of every poore man in his neede, which is an admirable comfort to poore man in that disease; also I find we have many good things that heale the Scurvy well at land, but the sea-surgeon shall doe little good at sea with them, neyther will they indure. The vse of the juice of Lemmons is a precious medicine and well-tryed, being sound and good, let it have the chiefe place for it will deserve it, the vse whereof is; it is to be taken each morning, two or three spoonfuls, and fast after it two houres, and if you adde one spoonefull of Aquavitae thereto to a cold stomacke, it is the better. Also if you take a little thereof at night it is good to mixe therewith with some sugar, or to take of the syrup thereof is not amisse.

"Some Surgeons also give of this juice daily to the men in health as a preservative, which course is good if they have store, otherwise it were best to keepe it for neede. I dare not write how good a sauce it is at meat, least the chiefe in the ships waste it in the great Cabins to saue vinegar. In want whereof vse the juice of Limes, Oringes or Citrons, or the pulp of Tamarinds: and in want of all these vse oyle of Vitrioll as many drops as may make a cup of Beere, water or rather wine if it may be had, onely a very little as it were sower, to which you may also add sugar if you please, or some sirups according to your store and the necessity of that disease; for of my experience I can affirme that good oyle of Vitrioll is an especial good medicine in the cure of Scurvy, as also in many other greefes."

Kramer, who was Physician to the Imperial Armies in Hungary from 1720 to 1730, says:

"But if you can get green vegetables; if you can prepare sufficient quantity of fresh, noble antiscorbutic juices; if you have oranges, lemons or citrons; or their pulp and juice preserved with sugar in casks, so that you can make lemonade, or rather give to the quantity of three or four ounces of their juice in whey, you will, without other assistance, cure this dreadful evil."—KRAMER, *Medicina Castrensis*.

juice. Ten fluid ounces (half a pint), or ten ordinary rations of lime juice, may by careful evaporation be reduced to a semi-solid extract, which can be nearly all contained in a tablespoon. This extract, further, may be mixed with sugar, or with rum, or with rum and sugar, in the proper proportional quantities of each for use as a ration, and the inconvenience of separate measurements be avoided, while the sugar or rum, or both of them, would tend to preserve the extract unchanged. A concentrated preparation, having a semi-liquid form at low temperatures, and being, therefore, readily divided into definite rations, may also be obtained by mixing extract of lime juice with glycerine, in such proportion as may be found most convenient—the freezing point of glycerine being so low as -40° Far.; and this preparation, like the others mentioned, would be less liable to undergo decomposition than the simple extract, and still less so than the crude juice, on account of the well-known preservative power of glycerine. One of the most convenient concentrated preparations of lime juice is, however, that in which the extract is converted into the form of lozenge, of which two kinds, prepared by Mr. Gale, were submitted to the Committee and to several of the witnesses, and pronounced to be pleasant and to possess the characteristic fragrance of lime juice (5395, 8617). In one of them the ordinary ration of an ounce of lime juice is represented by four lozenges, and in the other by three lozenges. Four of either kind weigh only half an ounce, and no fuel would be consumed nor time lost were they used by sledge travellers. A preparation was also submitted to the Committee by Mr. White, in which extract of lime juice is contained in biscuits. As the biscuits, however, are not very palatable, their regular use would probably become distasteful.

None of these preparations, however, have been subjected to actual trial, and until it has been experimentally demonstrated that they are as efficient as crude lime juice in preventing or curing scurvy, it would be highly imprudent to use them in sledge travelling. The whole teaching of Pharmacology, at the same time, undoubtedly indicates, so far as can be done in the absence of experiment, that they would be found to possess the valuable properties of lime juice.

Lime juice when carried in the ordinary and crude state by sledge parties has not only the inconvenience of materially adding to the weight of the equipment, but also of being difficult to use on account of its assuming the solid frozen form when subjected to a low temperature,* and on account of its requiring to be diluted with water. Additional fuel must, therefore, be carried on the sledge, and additional time must be occupied in thawing it, and in thawing the water with which to dilute it. In order to some extent to obviate these difficulties, it has been proposed that the lime juice should be mixed with tea, rum, or pemmican when these substances are about to be consumed. The most feasible of these proposals is undoubtedly the last, with respect to which Sir Alexander Armstrong observed, “I believe that if the lime juice were so added to the pemmican when the mess was made, it would render the pemmican much more palatable, the men would take to it more readily, and it would aid very materially the assimilative process of digestion, and thus, in my opinion, would enable them to eat their full allowance, or even more if they could get it.” (9008).†

The further inconvenience results from the freezing of lime juice, of the bottles in which it is carried being broken by the expansion of the juice. Besides the adoption of obvious precautions to lessen the risk of this accident occurring, advantage would probably be gained by carrying the lime juice in conical bottles, as suggested by Professor Macdonald (4937).

The question of the deterioration of lime juice by its subjection to very low temperatures (3472) has been set at rest by the observations made with the lime juice found at Polaris Bay. It had been subjected to the temperature of an arctic climate for five years, and was found at the end of that time to possess most marked antiscorbutic properties; for it is stated to have materially aided the recovery of a large number of patients suffering from scurvy who were treated with it (2886–2902).

The fully established value of lime juice and the conveniences attending its use render it greatly superior to all other suggested antiscorbutic remedies. Owing to the great difficulty of obtaining fresh vegetable food in arctic regions, some advantage may no doubt be derived from cultivating quickly-growing hardy vegetables, as was done in the recent and in previous expeditions. A list of the plants most suitable for this purpose is contained in a letter from Dr. Hooker, which was brought before the

* Unfortified lime juice freezes at $+25^{\circ}$ Far.; and when fortified with 10 per cent. of spirit, at about $+15^{\circ}$ Far. (4936).

† It is interesting to find that Solomon Albertus, when recommending the use of lemons and oranges in scurvy (1573), indicates that their juices may be sprinkled on roast meats. See also Extracts from John Woodall's “The Surgeon's Mate,” foot note, p. xxvii.

Committee by Captain Feilden (Appendix, No. 26), and it includes mustard, cress, radishes and turnips (for the "tops" only). It may prove useful to state that of these, mustard and cress are the most rapid in their growth, while cress grows somewhat less rapidly than mustard. In order to rear these vegetables to the best advantage it would be advisable to provide a few light cucumber frames (2738). Such vegetables must however be regarded mainly as luxuries, dependence being chiefly placed upon the antiscorbutic character of the ordinary dietary, aided by the valuable properties of lime juice.

Some evidence has likewise been incidentally laid before the Committee of the value of the dandelion plant in curing scurvy in the Crimea (5424), and of the leaf of a plant called "spekboom" (*Portulacaria afra*) in curing this disease at the Cape (8528).

We have referred to the obvious advantages that would be derived from the substitution of concentrated preparations of lime or lemon juice for the crude juice. It seems of the greatest importance that the value of these preparations should be thoroughly tested; in the first place, with respect to their curative value, and then, if these trials prove satisfactory, with respect to their prophylactic value. Attention may in the first instance most hopefully be directed to the extract of lime juice and to the citric and other acids contained in it.

We have also had occasion to refer to the incompleteness of the present knowledge of the nature of scurvy. The essential nature of the disease, the exact abnormal conditions which are present, and even the variations from the standard of health in the performance of many important functions during its existence are as yet unknown. Investigation of these several points is likewise required, and might with advantage include an examination of the effects on the excretions of many articles of food reputed to be antiscorbutic.

The details of the observations and experiments required for extending our knowledge on those subjects may be left to any competent investigator who may assume, or be directed to undertake, the investigation. The field of observation, however, is limited, while the objects to be attained are of the greatest value not to science only, but to the interests of the human race generally, and especially to those of this nation. We believe that no Department of the Government of this country but that to which this paper is about to be submitted can afford the requisite opportunities for attaining the objects referred to.

PAPERS FORWARDED WITH THE REPORT.

- (1) Provisions and Medical Comforts supplied to and returned by the Arctic Expedition, including Lists of Savings.
- (2) Medicines and Medical Utensils supplied to the Expedition.
- (3) Reports of Analyses from Mr. Bell, of the Laboratory, Somerset House, on Lime Juice and Compressed Tea.
- „ „ „ Professor Frankland on Pemmican.
- „ „ „ Professor Attfield on Vegetables and Lime Juice.
- (4) Reports of Survey on certain Articles of Provisions to which exceptions were taken in the Evidence tendered to the Committee.
- (5) Summary of Proceedings.
- (6) Index of Papers in Appendix.
- (7) Index of other Papers preserved for Reference.

RETURN of the PROVISIONS and SPECIAL CLOTHING supplied to the two Ships of the Arctic Expedition, 1875.

Article.	"Alert."		"Discovery."		Remarks.
	Supplied.	Returned into Store.	Supplied.	Returned into Store.	
Biscuit lbs.	23,750	6,460	24,600	13,070	
Rum gals.	41	nil	41	nil	
" red heart "	75	18½	55	54¼	
" strong "	1,423	746⅞	1,315	777¾	
Sugar lbs.	12,850	4,750	12,100	6,155	
Chocolate, ordinary .. "	3,050	1,007	2,850	1,159	
" soluble "	880	208	830	337	
Tea "	967	288	911	443	
" consolidated "	112	nil	112	14¾	
Salt pork "	20,500	15,000	1,6000	8,700	
Split peas "	4,230	13,438	4,230	2,642	
Salt beef "	19,800	5,000	15,900	9,164	
Fresh beef "	1,848	—	1,939	—	
Vegetables "	927	—	960	—	
Flour, kiln dried "	29,500	25,817	25,250	15,062	
" not kiln dried "	26,000	10,750	25,000	7,186	
Rice "	112	112	112	54	
Celery seed "	25	20	20	15	
Pearl barley "	112	70	112	112	
Pickles of sorts "	4,304	2,776	3,973	2,020	
Meat biscuit "	1,100	717	1,100	985	
Bacon, boiled "	5,960	1,840	3,520	1,410	
Pemmican "	7,552	3,084*	6,968	4,178†	
Suet, clarified "	1,050	490	996	598	
Raisins "	1,058	539	991	656	
Oatmeal "	144	79	144	84	
Mustard "	305	172	290	205	
Pepper "	152	47	147	65	
Vinegar gals.	9	nil	10	nil	
" concentrated "	51	23	51	38	
Lime juice lbs.	4,240	1,012	3,960	1,290	
Wine, port gals.	29	7¼	28	3¾	
" sherry "	27	7	27	26	
" tent bots.	12	9	12	nil	
Boiled beef lbs.	10,008 (a)	2,252	10,008 (a)	2,464	(a) Consisting of New Zealand cure, in 4 lb. tins.
(Ordinary Navy Service preserved meat.)			Boiled mutton 56		
Essence of beef ¼ pts.	36	36	36	8	
Calf's foot jelly lbs.	24	1	24	12	
Preserved fowl "	250	6	249	nil	
Extractum carnis "	1½	nil	1½	nil	
Preserved potatoes "	6,400	3,087	6,000	3,406	
" carrots "	5,640	2,952	5,280	2,216	
Compressed vegetables "	544	384	512	328	
" cabbage "	544	316	512	416	
**Preserved meats "	‡34,440	17,026‡	§32,100	17,317§	

*Sweet lbs.	1,344
Plain lbs.	1,740
Total	3,084

	Supplied.	Returned.
‡Boiled beef	6,480	3,518
Roast beef	6,480	3,584
Rump steak	3,240	1,474
Hotch potch	4,260	2,480
Roast mutton	6,480	1,768
Ox cheek and vegetables	4,260	1,888
Minced collops	3,240	2,314
Total	34,440	17,026

†Sweet lbs.	2,500
Plain lbs.	1,678
Total	4,178

	Supplied.	Returned.
§Boiled beef	6,060	2,816
Roast beef	6,060	3,503
Rump steak	3,000	1,486
Hotch potch	3,960	2,018
Roast mutton	6,060	3,042
Ox cheek and vegetables	3,960	2,158
Minced collops	3,000	2,294
Total	32,100	17,317

Note.—There are 4 lb. and 6 lb. tins of each description enumerated above.

Note.—There are 4 lb. and 6 lb. tins of each description enumerated above.

** Specially prepared by Messrs. Hogarth and Co. for this expedition.

Article.	"Alert."		"Discovery."		Remarks.
	Supplied.	Returned into Store.	Supplied.	Returned into Store.	
Preserved onions .. lbs.	2,832	1,212	2,640	1,064	
Tongues "	180	24	180	36	
Burton ale hhd.	10	nil	10	nil	
Coffee, ground lbs.	420	152	406	210	
Chillies "	5	nil	5	nil	
Culinary herbs $\frac{1}{4}$ pts.	24	3	24	24	
Brandy gals.	28	$23\frac{3}{4}$	28	26	
Gin "	30	23	27	$24\frac{7}{8}$	
Whisky "	25	$23\frac{5}{8}$	25	$23\frac{1}{8}$	
Champagne bots.	48	30	48	28	
Mustard and cress seeds lbs.	50	35	50	36	
Findon haddocks "	100	nil	100	48	
Maccaroni "	112	28	112	112	
Condensed milk "	192	nil	192	102	
Chocolate and milk "	56	nil	56	16	
Curry paste "	50	8	50	33	
Baking powder "	100	82	100	97	
Normandy pippins "	1,210	485	1,130	620	
Gooseberries "	1,212	245	1,128	628	
Rhubarb "	1,212	176	1,128	392	
Cocoatina "	56	56	55	55	
Extract of meat "	25	12	25	12	
Egg powder "	14	nil	13	13	
Apple jelly "	45	6	45	16	
Malt "	400	345	400	320	
Arrowroot "	56	11	56	49	
Oysters tins.	250	nil	249	84	
Hops lbs.	24	17	24	20	
Onion powder "	50	35	50	50	
Tapioca "	56	56	56	56	
Loaf sugar "	224	112	224	182	
Black and red currants .. bots.	36	26	36	23	
Sago lbs.	112	56	112	104	
Cloves "	3	3	3	2	
Nutmegs "	3	$2\frac{3}{4}$	3	2	
Salt, fine white "	176	17	276	37	
Pickles, garlic "	25	18	25	nil	
Sheep No.	10	nil	10	nil	
Cocoa-nut stearine .. lbs.	2,242	446	2,207	672	
Dog biscuit "	4,690	210	4,214	nil	
Spirits of wine gals.	46	$6\frac{5}{8}$	44	nil	

REMARKS.

The larger expenditure of provisions in the "Alert" than in the "Discovery" arises from the former ship having on the average victualled 67 and the latter only 53 men, and that the "Alert," besides victualling some of the "Discovery's" sledge parties, furnished supplies for a larger number of depôts, and supplied a considerable quantity of antiscorbutic articles to the Danes settled on the coast of Greenland.

And the 0·64 parts of dry mineral matter containing (together with other less important substances) :—

Alkalies (as oxides)	..	..	..	0·19
Phosphoric acid (<i>i.e.</i> anhydride)	..	..	..	0·07

Average composition of Cabbage.

(The mean of several published analyses.)

					In 100 parts by weight
Water	..	..	..	..	89·0
Dry vegetable matter	..	..	..	..	9·8
Dry mineral matter	..	..	..	..	1·2
					<hr/> 100·0 <hr/>

The 9·8 parts of dry vegetable matter consisting of :—

Albuminoid matter	..	..	..	1·5
Celluloid matter or fibre	..	..	..	2·0
Fatty matter	..	..	..	·4
Other non-nitrogenous matter	..	..	..	5·9
				<hr/> 9·8 <hr/>

And the 1·2 of dry mineral matter containing (together with other less important substances) :—

Alkalies (as oxides)	..	..	..	0·63
Phosphoric acid (<i>i.e.</i> anhydride)	..	..	..	0·20

The figures of these tables of the composition of the sample of cabbage, show that while the vegetable constituents are in good proportion, there is considerable deficiency of mineral matter, especially of the saline material termed alkaline phosphate. In the first place, 0·64 per cent. of mineral matter is not only about half the average proportion, but is much less than the minimum hitherto obtained from cabbage. And in the second place, only about one-third of this already small amount of mineral matter is “alkalies,” whereas half the mineral matter should be of this character. Thirdly, the phosphoric acid, or rather phosphoric anhydride, is present to only about one-third the normal proportion.

As to the physiological import of so great a deficiency of alkaline phosphates in this sample of cabbage, I do not pretend to judge. At the same time, eminent authorities consider that these saline constituents of vegetables contribute very materially to the food value of the vegetables. I am of opinion that the Committee should ascertain, if possible, to what extent the cabbage contributed to the dietary of the crews. The Committee would then probably seek a medical opinion on this point.

As to the cause of the deficiency, the chemical results are suggestive of loss of juice from the original cabbage. If the fresh cabbages were submitted to pressure before drying to such an extent as to bruise the leaves and cause an outflow of juice, that would exactly explain the facts revealed by the analysis.

I may add that experiments undertaken with the view of ascertaining whether the cabbage yielded as much organic acid as a sample taken from my own garden, also pointed to loss of juice from the original cabbage.

One pound of this dried cabbage represents, in weight, seven pounds of the fresh vegetable.

4. Dried compressed mixed Vegetables.

The sample yielded :—

					In 100 parts by weight.
Water	..	..	..	..	15·61
Dry vegetable matter	..	..	..	..	80·29
Dry mineral matter	..	..	..	..	4·10
					<hr/> 100·00 <hr/>

The 80·29 parts of dry vegetable matter yielded :—

Albuminoid matter	..	..	..	..	8·11
Celluloid matter, or fibre	..	..	..	..	4·94
Fatty matter	..	..	..	..	1·82
Other non-nitrogenous matter	..	..	..	..	65·42
					<hr/>
					80·29
					<hr/>

And the 4·1 of dry mineral matter yielded (together with other less important substances) :—

Alkalies (as oxides)	..	..	..	..	1·82
Phosphoric acid (<i>i.e.</i> anhydride)	..	..	..	..	·47

Composition of the original undried mixed Vegetables.

(Based on the assumption that they contained 85 per cent. of water.)

					In 100 parts by weight.
Water	..	..	..	..	85·0
Dry vegetable matter	..	..	..	..	14·3
Dry mineral matter	..	..	..	..	·7
					<hr/>
					100·0
					<hr/>

The 14·3 parts of dry vegetable matter containing :—

Albuminoid matter	..	..	..	..	1·5
Celluloid matter or fibre	..	..	..	..	1·0
Fatty matter	..	..	..	..	·3
Other non-nitrogenous matter	..	..	..	..	11·5
					<hr/>
					14·3
					<hr/>

And the 0·7 parts of dry mineral matter containing (together with other less important substances) :—

Alkalies (as oxides)	..	..	..	..	0·31
Phosphoric acid (<i>i.e.</i> anhydride)	..	..	..	..	0·08

There are no published analyses of “mixed vegetables,” and if there were, the mixture might not be similar to that of the sample. At the same time, from my knowledge of such matters, I should form the opinion that the sample of mixed vegetables, like that of the cabbage, though not to the same extent, had lost a portion of its original juice—perhaps by pressure—and, consequently, a portion of its valuable saline constituents.

Organic Acids.—Some experiments, commenced with the object of ascertaining the proportion of organic acids in the vegetables, led to no useful results. Comparative experiments with fresh and preserved vegetables were tried, but were abandoned. Larger samples of the preserved vegetables, and much time, would be necessary for such an investigation.

Conclusions.

1. The Carrots were of good quality.
2. The Potatoes were of good quality.
3. The Cabbage was deficient in important saline constituents.
4. The Mixed Vegetables are probably somewhat deficient in saline substances.

JOHN ATTFIELD.

No. 3.

REPORT ON A SAMPLE OF "LIME JUICE" FROM THE RESIDUAL
STORES OF THE "ALERT" AND THE "DISCOVERY."

BY PROFESSOR ATTFIELD,

Member of the Council of the Chemical Society; Professor of Practical Chemistry to the Pharmaceutical
Society of Great Britain; Author of a Manual on General, Medical and Pharmaceutical Chemistry, &c.*London, 17, Bloomsbury Square, W.C.,
March 12th, 1877.*

This sample of "Lime Juice" contains 7·2 per cent. of citric acid.

It contains 7·23 per cent. by weight of absolute alcohol, which is equivalent to $15\frac{3}{4}$ per cent. by volume of "proof spirit."

It yields only 0·44 per cent. of mineral matter (or ash).

It does not contain any sulphuric acid, or any hydrochloric acid, or any acetic acid.

It contains only just those traces of tartaric acid which, from my own researches, I am able to say are natural to Lime Juice and Lemon Juice.

In my opinion this sample of Lime Juice is natural and normal Lime Juice, of good quality, preserved by a proper proportion of alcohol.

JOHN ATTFIELD.

No. 4.

ABSTRACTS OF REPORTS ON PROVISIONS RETURNED FROM THE
ARCTIC EXPEDITION, SURVEYED ON BOARD THE "DUKE OF
WELLINGTON."

1. By the Petty Officers—

Salt Beef—Very salt and tough; had been soaked only for ten hours. On soaking this meat for twenty-four hours, the saltiness was entirely removed, and the meat was highly approved of, the opinion being it resembled corned beef more than salt junk.

Salt Pork—Had better and had worse, but not so good as shore corned pork.

Ox-cheek and Vegetables—Fair.

Ox-cheek without Vegetables—Very good.

Minced Collops and Vegetables—Not sufficient by itself for a meal.

Minced Collops without Vegetables—Better than the usual preserved meats supplied.

2. By the Chief Instructor of Cookery—

Salt Beef and Salt Pork—Superior to any that has ever been served out to me, either on board ship, in the Crimea, in India, or while serving ashore at home, my experience extending over a period of 24 years.

The Ox-cheek of both kinds was very good, sweet, and as good as when first potted.

The Minced Collops were also good, but unsuitable for a meat ration for dinner, and should be used in the form of soup, or an auxiliary to morning and evening meals.

On the second occasion the salt beef was parboiled, and then changed into another vessel containing boiling water, in which it was allowed to simmer till properly cooked.

SUMMARY OF THE PROCEEDINGS OF THE COMMITTEE.

Wednesday, January 10th—

Met at 11 a.m., adjourned at 4 p.m.

Examined—Captain Sir George Nares, R.N., K.C.B., F.R.S.

Thursday, January 11th—

Met at 11 a.m., adjourned at 4.50 p.m.

Examined—Captain Sir George Nares, R.N., K.C.B., F.R.S.

Friday, January 12th—

Met at 11 a.m., adjourned at 5 p.m.

Examined—Captain Sir George Nares, R.N., K.C.B., F.R.S.; Captain Stephenson R.N., C.B.

Saturday, January 13th—

Met at 11 a.m., adjourned at 5 p.m.

Examined—Captain Markham, R.N.; Lieut. May, R.N.

Monday, January 15th—

Met at 11 a.m., adjourned at 5.30 p.m.

Examined—Commander Beaumont, R.N.; Lieut. Rawson, R.N.; Lieutenant Giffard, R.N.

Tuesday, January 16th—

Met at 11 a.m., adjourned at 4.45 p.m.

Examined—Commander Aldrich, R.N.; Commander Parr, R.N.; Lieutenant Egerton, R.N.

Wednesday, January 17th—

Met at 11 a.m., adjourned at 5 p.m.

Examined—Dr. Colan, Fleet-Surgeon, M.D., R.N.

Thursday, January 18th—

Met at 11 a.m., adjourned at 6.15 p.m.

Examined—Dr. Colan, Fleet-Surgeon, M.D., R.N.; Dr. Moss, Staff-Surgeon, M.D., R.N.; Dr. Ninnis, Fleet-Surgeon, M.D., R.N.

Friday, January 19th—

Met at 11 a.m., adjourned at 5.15 p.m.

Examined—Dr. Coppinger, Staff-Surgeon, M.D., R.N.; Captain R. V. Hamilton, R.N., C.B.

Saturday, January 20th—

Met at 11 a.m., adjourned at 5.25 p.m.

Examined—Rear Admiral Richards, C.B., F.R.S.; Rear-Admiral Sir Leopold M'Clintock; Captain Hobson, R.N.

Monday, January 22nd—

Met at 11 a.m., adjourned at 4.45 p.m.

Examined—Dr. Toms, Fleet-Surgeon, R.N.; Captain Allen Young; Dr. Scott, Fleet-Surgeon, R.N.

Tuesday, January 23rd—

Met at 11 a.m., adjourned at 5.15 p.m.

Examined—Dr. Ede; Dr. Lyall, Deputy Inspector-General, M.D., R.N.; Dr. Piers, Deputy Inspector-General, R.N.

Wednesday, January 24th—

Met at 11 a.m., adjourned at 5.40 p.m.

Examined—Commander Cameron, R.N., C.B., D.C.L.; Dr. Macdonald, M.D., F.R.S., Deputy Inspector-General, R.N.; Surgeon-Major Dr. De Chaumont, M.D.

Thursday, January 25th—

Met at 11 a.m., adjourned at 4.25 p.m.

Examined—Dr. Pavy, M.D., F.R.S.; George Busk, Esq., F.R.S.; Dr. Guy, M.D., F.R.S.

Friday, January 26th—

Met at 11 a.m., adjourned at 4.10 p.m.

Examined—Dr. Buzzard, M.D.; Harry Leach, Esq.; Dr. Dickson, M.D., R.N.

Saturday, January 27th—

Met at 11 a.m., adjourned at 5 p.m.

Examined—Vice-Admiral Ommaney, C.B., F.R.S.; Captain Feilden, R.A.; Rear-Admiral Pullen.

Monday, January 29th—

Met at 11 a.m.; adjourned at 4.40 p.m.

Examined—Mr. Bayley, Boatswain, R.N.; Mr. Organ; Mr. Murray, Harbour-Master at Harwich; Dr. Barnes, M.D.

Tuesday, January 30th—

Met at 11 a.m., adjourned at 5 p.m.

Examined—Alexander Gray, Ice Quartermaster; Thomas Rawlings, Captain of Forecastle, R.N.; Colour-Sergeant Wood, R.M.; Mr. Emmerson, Boatswain, R.N.; William Jenkins, Chief Carpenter's Mate, R.N.

Wednesday, January 31st—

Met at 11 a.m., adjourned at 4.55 p.m.

Examined—Surgeon-Major Dr. William Munro, M.D., C.B.; Dr. Rac, M.D., F.R.G.S.; Mr. Mitchell, Paymaster, R.N.

Saturday, February 3rd—

Met at 11 a.m., adjourned at 12.10 p.m.

Wednesday, February 21st—

Met at 11 a.m., adjourned at 3 p.m.

Examined—Sir Alexander Armstrong, K.C.B., F.R.S., LL.D., Medical Director-General of the Navy.

Thursday, February 22nd—

Met at noon, adjourned at 4.15 p.m.

Examined—Sir Alexander Armstrong, K.C.B., F.R.S., LL.D., Medical Director-General of the Navy.

Wednesday, February 28th—

Met at 11 a.m., adjourned at 5.50 p.m.

Examined—Captain Sir George Nares, R.N., K.C.B., F.R.S.

Thursday, March 1st—

Met at 11 a.m., adjourned at 3.30 p.m.

Friday, March 2nd—

Met at 1.30 p.m., adjourned at 2.20 p.m.

Saturday, March 3rd—

Met at 11 a.m., adjourned *sine die* at noon.

No. 6.

INDEX OF RETURNS TO BE PRINTED FOR THE APPENDIX TO THE EVIDENCE.

Correspondence subsequent to the return of the Expedition, (Admiralty.)

Sailing orders of "Alert."

Medical Director-General's Memorandum.

Return of Dietary from "Alert," showing changes and reasons for the same.

Daily winter routine of "Alert."

Regulations of drying room of "Alert."

Diagram of total darkness from "Alert."

Medical reports of officers and men ordered for spring sledge work from "Alert."

Sailing orders of "Discovery."

Return of dietary from "Discovery," showing changes and reasons for them.

Daily winter routine of "Discovery."

Medical reports of officers and men required for spring sledging from "Discovery."

Medical instructions issued for the guidance of the officers in command of the sledge parties of the "Alert."

Chemical analysis of the air inside and outside the ship while in winter quarters, from "Alert."

Ditto ditto from "Discovery."

Medical instructions for the guidance of the officers in command of the sledging parties from the "Discovery."

Sections and plans of "Alert," "Discovery," and "Resolute," with cubical contents of decks, cabins, &c.
 Abstracts of temperature return of "Alert."
 Ditto ditto "Discovery."
 Nosological return of "Alert." (Abstract).
 Ditto ditto "Discovery." Ditto.
 Comparative return of ages of men employed on Arctic Service.
 Dietary.—Arctic Committee.
 Ditto Comparison of Convict and Arctic.—Dr. Guy.
 Antiscorbutic plants.—Dr. Hooker and Captain Feilden.
 Analysis of pemmican, preserved potato and sledge work.—Dr. De Chaumont.
 Arctic papers.—Dr. Rae.
 Sledge party returns.
 Scurvy in former Arctic expeditions—Sir Alexander Armstrong.

No. 7.

INDEX OF RETURNS CALLED FOR BY THE COMMITTEE, TO BE PRESERVED FOR FUTURE REFERENCE, BUT NOT PRINTED.

1. List of Captains of messes of "Alert," showing ages, ratings, and whether captains of sledges.
 2. Comparative table of sledge dietaries.
 3. Ditto ditto weights.
 4. Temperature return alongside and on the lower deck during the winter from "Alert." (Abstract of this printed.)
 5. Extracts from logs of the expedition in regard to exercise during winter.
 6. Equipment of sledge crews.
 7. Return of scurvy in each sledge crew.
 8. List of Captains of messes of "Discovery," showing age, ratings, and of captains of sledges.
 9. Sledge rations of "Discovery," weights.
 10. Comparative mean temperatures in Arctic voyages.
 11. Temperature return alongside and on the lower deck of the "Discovery" during the winter. (Abstract of this printed.)
 12. Comparative absence of sunlight in Arctic voyages.
 13. Estimation of carbonic acid.—Dr. Moss.
 14. Return of the personal service of the officers and men of the "Alert."
 15. Ditto ditto ditto "Discovery."
 16. Sketch of snow shoes.—Dr. Rae.
 17. Alteration of sledge lading required for the carriage of lime juice.
 18. Sledge party returns.—Markham.
 - (1) Meteorological.
 - (2) Sledge work.
 - (3) Distance travelled.
 19. Ditto ditto May.
 20. Ditto ditto Beaumont.
 21. Ditto ditto Rawson.
 22. Ditto ditto Giffard.
 23. Ditto ditto Aldrich.
 24. Ditto ditto Moss.
 25. Sledge weights

" provisions	}	From Admiral Ommaney.
Dietary of H.M.S. "Assistance"		
 26. Reports on American pemmican, Polaris Bay.—Dr. Coppinger.
 27. On spekboom.—Professor Oliver.
 28. Remarks on scurvy in South America and Australia.—Admiral Sir James Sullivan.
 29. Scurvy instructions.—Board of Trade.
 30. Lime juice biscuit.—Preparation of Mr. White.
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ALPHABETICAL LIST OF WITNESSES.

Name.	Rank.	Nos. of Questions in Evidence.
†Aldrich, Pelham	Commander, R.N.	Nos. 1252 to 1409
*Armstrong, Sir Alexander, K.C.B., F.R.S.	{ The Director-General, Medical Department of the Navy .. Inspector-General of Hospitals and Fleets, R.N. }	„ 8930 to 9302
Barnes, Robert, M.D.	„	„ 7020 to 7165
*Bayley, Richard	Boatswain, R.N.	„ 6244 to 6528
†Beaumont, Lewis A.	Commander, R.N.	„ 840 to 1029
„	„	„ 1175 to 1200
Busk, George, F.R.S.	„	„ 5246 to 5307
Buzzard, Thomas, M.D.	„	„ 5417 to 5535
Cameron, Verney L., C.B., D.C.L.	„	„ 4691 to 4824
†Colan, Thomas, M.D.	Commander, R.N.	„ 1613 to 2186
†Coppinger, Richard W., M.D.	Fleet-Surgeon, R.N.	„ 2742 to 2992
De Chaumont, Francis S. B.F., M.D.	Staff-Surgeon, R.N.	„ 4958 to 5139
*Dickson, Walter, M.D.	Surgeon-Major	„ 5616 to 5729
*Ede, Charles	Staff-Surgeon, R.N.	„ 4040 to 4263
†Egerton, George Le Clerc	„	„ 1527 to 1612
†Emmerson, George W.	Lieutenant, R.N.	„ 8081 to 8368
†Feilden, Henry W.	Boatswain, R.N.	„ 5919 to 6085
†Giffard, George Augustus	Captain, R.A.	„ 1201 to 1251
†Gray, Alexander	Lieutenant, R.N.	„ 7166 to 7620
Guy, William A., M.D., F.R.S.	Ice-Quartermaster	„ 5308 to 5416
*Hamilton, Richard Vesey, C.B.	„	„ 2993 to 3091
*Hobson, William R.	Captain, R.N.	„ 3408 to 3550
†Jenkins, William	Captain, R.N.	„ 8369 to 8508
Leach, Harry	Carpenter's Mate	„ 5536 to 5615
*Lyll, David, M.D.	„	„
*McClintock, Sir F. Leopold, Kt., F.R.S.	Deputy Inspector-General of Hos- pitals and Fleets, R.N.	„ 4264 to 4441
Macdonald, John D., M.D., F.R.S.	Rear Admiral	„ 3242 to 3407
„	Deputy Inspector-General of Hos- pitals and Fleets, R.N.	„ 4825 to 4957
†Markham, Albert H.	Captain, R.N.	„ 533 to 786
†May, William H.	Lieutenant, R.N.	„ 787 to 839
†Mitchell, Thomas	Paymaster, R.N.	„ 8888 to 8929
†Moss, Edward, M.D.	Staff-Surgeon, R.N.	„ 2187 to 2497
Munro, William, M.D. C.B.	Surgeon-General	„ 8509 to 8699
*Murray, William	„	„ 6826 to 7019
*†Nares, Sir George Strong, K.C.B., F.R.S.	Captain, R.N.	„ 1 to 253
„	„	„ 9303 to 9387
†Ninnis, Belgrave, M.D.	Fleet Surgeon, R.N.	„ 2498 to 2741
*Ommanney, Erasmus, C.B., F.R.S.	Vice-Admiral	„ 5730 to 5918
*Organ, Joseph	„	„ 6529 to 6825
†Parr, Alfred A. C.	„	„ 1410 to 1526
Pavy, Frederick W., M.D., F.R.S.	Commander, R.N.	„ 5139 to 5245
*Piers, Henry	„	„
„	Deputy Inspector-General of Hos- pitals and Fleets, R.N.	„ 4442 to 4690
*Pullen, William J. S.	Rear-Admiral	„ 6086 to 6243
*Rae, John, M.D.	„	„ 8700 to 8887
†Rawlings, Thomas	Captain Forecastle	„ 7621 to 7853
†Rawson, Wyatt	Lieutenant, R.N.	„ 1030 to 1174
*Richards, George H., C.B., F.R.S.	Rear-Admiral	„ 3092 to 3241
*Robertson, John, M.D.	Deputy Inspector-General of Hos- pitals and Fleets, R.N.	Letter at end of Evidence, p. 316
*Scott, Robert C.	Fleet-Surgeon, R.N.	Nos. 3882 to 4039
†Stephenson, Henry F., C.B.	Captain, R.N.	„ 254 to 532
*Toms, Francis Y.	Fleet-Surgeon, R.N.	„ 3551 to 3760
†Wood, William	Color-Sergeant, R.M.	„ 7854 to 8080
*Young, Allen	Captain	„ 3761 to 3881

The † against a witness's name denotes that he served in the Recent Expedition.

The * that he served in a former Polar Expedition.

For List of the Ships served in by witnesses who took part in former Expeditions, see page 413.

MINUTES OF EVIDENCE

TAKEN BEFORE

A COMMITTEE APPOINTED BY THE ADMIRALTY TO ENQUIRE INTO THE OUTBREAK OF SCURVY IN THE RECENT ARCTIC EXPEDITION,

AT 13, DELAHAY STREET, WESTMINSTER.

WEDNESDAY, 10TH JANUARY, 1877.

PRESENT :

ADMIRAL SIR JAMES HOPE, G.C.B., in the Chair.

ADMIRAL SIR R. COLLINSON, K.C.B.

VICE-ADMIRAL E. A. INGLEFIELD, C.B., F.R.S.

JAMES J. L. DONNET, Esq., M.D., Inspector-General of Hospitals and Fleets, R.N.

THOMAS R. FRASER, Esq., M.D., F.R.S.E.

H. J. VANSITTART NEALE, Esq., Secretary.

CAPTAIN SIR GEORGE STRONG NARES, R.N., K.C.B., F.R.S., *examined.*

1. (*The Chairman.*) Was the "Alert" commissioned by you as Captain on the 15th of April, 1875?—Yes.

2. When was the "Discovery," commanded by Captain Stephenson, placed under your command?—By Admiralty orders of the 25th of May, 1875.

3. Was the equipment of the "Discovery," so far as regards the special service on which she was to be employed, placed under your supervision, and if you received any order to that effect, produce it?—I was more or less in constant communication with the Admiralty Committee, under whose authority the ships were equipped; but I considered myself responsible for the special equipment of both ships. The distinct order to me about the equipment is in virtue of paragraph 2 of my orders of the 25th of May, 1875.

4. It is understood that the Admiralty appointed a Committee, consisting of Admirals Richards, Sir Leopold McClintock, and Sherard Osborn, to report to their Lordships on, first, the special equipment of the ships; and, secondly, the instructions for the conduct of the Expedition. Were you placed in official communication with this Committee, and if you received any order to that effect, produce it?—I was ordered to place myself in communication with the Arctic Committee, and although I have not the order I will endeavour to obtain it.

5. Produce all the instructions issued by the Admiralty for your guidance in the conduct of the expedition?—I produce the sailing orders of the 25th of May, 1875, accompanied by papers and correspondence relating to the equipment and fitting out of the Arctic Expedition of 1875, including the report of the Admiralty Arctic Committee. (Appendix No. 1.)

6. Were these accompanied by a letter from the Secretary to the Admiralty, dated May 8th, 1875, forwarding, for your information, and that of Captain Stephenson, and the medical officers of the expedition, a memorandum from the Medical Director-General of the Navy, containing suggestions and recommendations as to the health of the Arctic Expedition of 1875-1876?—Yes. (Appendix No. 2.)

7.* In the copy of the said memorandum, having numbered the paragraphs, I request that you will state, as I read them *seriatim*, whether the suggestions and recommendations therein contained were carried out; or, if otherwise, to what extent, and the grounds on which they were not fully complied with: "First—In connection with arctic service there is nothing more important than the selection of officers and men with regard to their physical fitness, and I would also say moral fitness, where it can be ascertained, as there is no service in which both are more severely taxed: but the remarks to which I have already drawn the attention of the Arctic Committee on this important question appear to be now unnecessary, as the officers and crew had then been entered." Was the recommendation herein contained attended to in the selection of the officers and crew?—Previous to receiving Sir Alexander Armstrong's recommendations, my former experience in the arctic service had impressed me most fully how important it was to exercise the greatest care in choosing the officers and men for arctic service; and the standard on which the men were entered was, after private consultation with other arctic officers, established by myself, and the men and officers were chosen by that standard, and this agreed in all respects with Sir Alexander Armstrong's suggestions received afterwards. I may state that two of the crew were entered below the standard, but only upon very strong recommendations from their previous commanding officers.

8. (*Dr. Fraser.*) Are you prepared to give us the standards now?—I believe the standard of age was between 32 and 25. The reason for not taking younger men than 25 was partly to ensure their medical and moral history being known. No man was taken who had previously ever been in the second class for conduct, and that with the limit of age ensured us the first class men of the navy. The standard of height was, I believe, from 5 ft. 8 in. to 5 ft. 5 in., in order to prevent obtaining heavy men, or men of too little strength.

9. I observe that you mention that two of the crew

Capt. Sir G.
S. Nares,
R.N., K.C.B.,
F.R.S.

10 Jan., 1877.

* The examinations were in some instances conducted on unrevised proofs, and the wording of the documents quoted from may in consequence be slightly different from the revised papers.

Capt. Sir G.
S. Nares,
R.N., K.C.B.,
F.R.S.
10 Jan., 1877.

were below the standard which you have now given. Did you find that these two men suffered in any way from being selected although below the standard you have named?—Perhaps you will allow me to defer an answer to that question until I have referred to the papers; but I may state that after the winter they were both weaker and of less use to the expedition than the generality of the ship's crew. The smallest one was the most severely attacked by scurvy, and had been previously nearly useless as a dragger of a sledge.

10. May I ask you if you are able to tell us in what respects these two men differed from the standard?—I should think they were not higher than 5 ft. 4 in., the smallest one was even shorter, but was entered in consequence of being a very good gymnast, an amusing character for the winter, and an active man generally, and I thought that his activity would be beneficial, notwithstanding his possessing less power.

11. Then the variation from the standard was merely in respect to height, as I understand you?—Every man was brought before myself personally, and also before two other executive officers and before three medical men; and, not being entered for probably two or three days after passing his examination, we had very fair means of judging of his whole character.

12. May I ask you whether both of these men were affected by scurvy?—Chalkley, the smaller one, had a very severe attack, and I believe Stone had also; but neither of these men were, or could be, employed on long sledge travelling; but Stone appeared to me to have suffered during the winter more than the generality of the men.

13. Were either of those two men, or were both of them, amongst the first who were attacked with scurvy?—They were used on short sledge journeys, and, in consequence of returning to their ship, they had short rests of two or three days, and were on a different diet to those employed on long journeys; but they were attacked, I think, as soon as any of the others engaged on the same work.

14. Not so soon, therefore, as those who were engaged on long journeys?—Generally speaking, the men engaged on long journeys were attacked earlier than those who, by returning on board, obtained rest and different diet.

15. Returning to the standard; you gave us a description of that standard. From your recent experience, would you feel inclined to modify it in any material respects?—I am more than ever certain that neither light men nor heavy men are fit for the severe work of arctic sledge travelling. With regard to age, I also think the limits are the best that could be chosen.

16. Then you think that the standard could not be improved, so far as your experience went?—Not in a general way; there may always be an exceptional case.

17. (*Dr. Donnet.*) You mentioned the particular examination made of those two men; was every man of the arctic ships examined by the medical officer of the expedition?—Certainly.

18. Were there any among the crew of these ships who had formed part of previous expeditions?—Nobody belonging to the expedition had been employed on arctic service, with the exception of myself, and six harpooners, who had previously been employed in whalers. Captain Markham had been in a whaler, but had not wintered in the ice.

19. (*Admiral Sir R. Collinson.*) Did both those men belong to the "Alert"?—They belonged to the "Discovery," but they wintered on board the "Alert."

20. Then the remark with respect to these two men applies to both crews?—To both crews.

21. (*Admiral Inglefield.*) Why was Stone selected?—On a recommendation from his commanding officer.

22. For what peculiarity of temperament or otherwise?—He was a lively, good-humoured, active man, and a very good character.

23. Can you inform us whether Chalkley had served much in tropical climates?—I do not remember, but his medical history sheet can be obtained, and that of Stone also.

24. (*Dr. Fraser.*) Were Chalkley and Stone examined and approved by the medical officers before being entered in the crews?—The report of the medical examination must certainly have stated that they were under the standard for height, and therefore left the responsibility with me in entering them.

25. (*Dr. Donnet.*) Was power given to you by the Admiralty to reject any man whom the medical officers suspected of unfitness for arctic service?—The entry of the men was totally in my hands, the medical officers examining the men I chose and reporting to me.

26. Were these two men chosen simply for their cheerful disposition, and the good they might do during the arctic winter?—Certainly not. The character I obtained from their commanding officers and their personal appearance led me to suppose that, although under my standard, they would be exceptional cases.

27. In what way did you consider them as exceptional cases?—That short, light men may exceptionally prove equal to arctic sledging work.

28. (*The Chairman.*) Proceeding to the second paragraph: "Assuming, therefore, that the crews of the ships have been selected as nearly as possible in accordance with my recommendation as to their physical fitness, being of good constitution, and sound in all respects, the great object now in view is to maintain them in the same state of health and vigour as when they were entered. This can only be done on polar service by the use of a liberal dietary, both in animal food and vegetables. I consider that the former should consist of 2 lbs. of meat daily, namely 1 lb. at dinner and half-a-pound each at breakfast and supper, with a proportionate quantity of vegetables and of antiscorbutics. I am not aware at present how far this scheme of diet will be carried out, but, if acted on, I would anticipate little or no impairment of the physical powers; but, on the contrary, with a scale of diet smaller than this I consider that debility of a scorbutic character must ensue, and that at an early period if the men are much exposed to hard work and intense cold; fresh preserved meat should alternate with salt meat each day, with a due quantity of vegetables; and the latter should be such as are of the most succulent character. I know of no vegetable to equal cabbage for such service. This and Edwards's preserved potato should, in my opinion, form the bulk of the vegetable food. Pickles of a succulent character should be added to the diet of each day that salt meat is issued in addition to the ordinary quantity of vegetables, and, except as an adjunct, soup should not enter largely into any diet list for working men as a substitute for meat. Assuming that provision may have been made for giving 2 lbs. of meat to each man daily in the proportions before stated, namely 1 lb. at dinner and $\frac{1}{2}$ lb. each at breakfast and supper, I consider that the breakfast and supper meat should be duly alternated as the dinner meat is from day to day." With reference to this paragraph, produce a return of the dietary on board the ships during their absence from England, showing the changes, if any, and stating why adopted?—I can give all information on the subject, and will produce the papers in a day or two. (Appendix No. 3.) In the meantime I may state, that the recommendations of Sir Alexander Armstrong were acted upon with the exception of the issue of 2 lbs. of meat daily, for at no one time could either the men or the officers consume that quantity. Soups were only issued as adjuncts.

29. (*Admiral Inglefield.*) When did you determine that 2 lbs. of meat could not be consumed by the men and the officers, and after what trial of the quantity ordered?—The stock of meat on board the ship was not sufficient to allow a ration of 2 lbs. of meat daily for three years' consumption. I therefore only issued the same dietary as had been generally used on the last British Arctic Expedition until the ship was

secured in winter quarters. Then, on consulting the petty officers, and informing them that I wished to raise the ration of meat to the utmost extent in my power, they informed me that they could not consume more than 1½ lb. in the twenty-four hours, and that a further issue would only cause waste. Considerable saving arose from this issue during the winter from the crew not taking up all that ration. In consequence of the recommendation of the Medical Director-General, a large extra supply of meat was carried to Disco by the "Valorous" for the use of the expedition, and as much of this as the ships could possibly stow in smooth water was taken on board.

30. (*Dr. Fraser.*) As a matter of fact you had enough meat to supply 2 lbs. after going into winter quarters?—I could not have supplied 2 lbs. of meat for three years, but my present experience shows me, I had in the expedition more meat than we could possibly have consumed in that time without reckoning on any game whatever.

31. I suppose you had about equal quantities of salt and preserved or fresh meat?—There was about an equal proportion of salt and preserved meats; there were over 500 days of salt meat and 550 days of preserved meats at a ration of a pound a-day, besides the extra quantity supplied at Disco. On the 9th of October, at a ration of 1½ lb., there were 470 days of salt and 463 days of preserved meat.

32. At the time that you ascertained that 1½ lb. was probably the maximum that could be consumed, were the crews using both the salt and the preserved meat in about equal quantities?—On first starting the preserved meat ration was ¾ lb. a-day, with either ½ lb. of soup or extra vegetables. On October 16th an increase was made of a ¼ lb., making a total of 1 lb. of preserved meat. At the same time the ration of salt pork, which occurred every fourth day, was also raised a ¼ lb.; but the ration of salt beef, which had previously been raised a ¼ lb., was reduced to the former amount in consequence of the men not consuming it all.

33. Then I understand you, that when you increased the ration of salt meat, you found that the men were unable to consume it; but did you attempt at all to increase the ration of fresh or preserved meat, excepting as you have mentioned?—The ration of both salt and preserved meat was increased at the same time, but the crew not consuming all the beef, that was discontinued. In the depth of the winter there was a certain saving on both preserved and salt beef. The men did not consume even that quantity, but it was always at their option to obtain it.

34. Have you any reason to think that, if the quantity of salt meat had been diminished, a larger quantity of fresh or preserved meat could have been consumed?—I think that salt meat should never be supplied for arctic service; but the present preserved beef does not admit of a change of diet sufficient for that to be accepted by itself as the necessary dietary.

35. (*Dr. Donnet.*) Does not preserved meat, from its continuance, become an insipid article of diet? Are not salt and corn beef required to remove this insipidity, and was the objection to the consumption of a greater quantity of preserved beef due to this insipidity?—I can only speak from my own experience. The officers obtaining as nearly as possible the same rations as the ship's company, I found the preserved meat, when continuously used for diet, very insipid, and there was a decided craving for other food. There was no other supply available but salt meat, and certainly salt meat was more pleasing to the palate than the preserved beef. The officers having a supply of sauces to mix with their preserved meat, perhaps felt this less than the ship's company did.

36. Did you make any provision of birds' eggs and of birds themselves, in your way along the coast of Greenland, and your visit to Carey Islands?—Owing to our passing through Melville Bay at the most appropriate time of the season, no delay whatever occurred to enable me to stop at the Loomeries for that purpose.

37. Did the officers take sheep or other live stock to sea with them?—There may have been a small supply of poultry. The "Alert" had no sheep; I am not certain about the "Discovery." Sheep were carried to Disco by the "Valorous," for the general use of the expedition. After leaving Disco, the officers certainly never had a fresh meat meal, unless it was in a general issue to the ship's company, until their return to England.

38. Had you any case of scurvy among the officers?—No case of scurvy was actually in the sick list, or appealed to the doctor on board the "Alert." Lieutenant Beaumont had scurvy in the "Discovery." But I believe some of the officers really had premonitory symptoms of scurvy.

39. Were these symptoms simply debility or soreness and swelling of the feet?—In the case of the officers I allude to, they kept their own counsel in the matter, and I can only state what I believe to have been the fact.

40. Do you suppose that a greater immunity from scurvy was enjoyed by the officers as compared with the men?—Most certainly.

41. Do you think that this immunity was in some measure due to the condiments and sauces, which assisted them to vary the provisions of the ship?—Without entering into the medical question, I do now conclude that the sauces and the private supply of preserved milk, and in a very great measure the private supply of wine, were the cause of the immunity of the officers.

42. Had the men consumed a larger amount of meat, whether salt or preserved, do you consider that this quantity would have assisted in enabling them to ward off the scurvy, which subsequently attacked them?—In no arctic expedition have the crew ever been able to consume even a pound and a quarter of meat. I am now referring back to the first expedition under Sir John Ross.

43. Have you any reason to suppose that preserved meat and pemmican possess equal nourishing qualities with fresh meat?—My opinion is that preserved meat is greatly inferior to fresh meat, and that pemmican is superior to preserved meat; but a continuation on a diet of pemmican can be stood by few people. Some men cannot eat pemmican at all.

44. Is it not a question with some that fresh meat, such as seal, musk ox, reindeer, and sea birds will of themselves preserve from scurvy? Do not the Esquimaux live almost exclusively upon fresh meat, only now and then enjoying the luxury of scurvy-grass, sorrel, cranberries, and reindeer moss, and yet are not known to suffer from scurvy?—In all the cases that have come under my notice, the scurvy gave way before an issue of fresh meat combined with lime juice. I cannot state what would have happened had there been no lime juice; but I know that scurvy is now, and has been for several years, very prevalent among the Esquimaux on the west coast of Greenland.

45. Were those observations limited to any part of the west coast of Greenland?—I cannot speak about the arctic highlanders except from knowledge obtained from publications, to which the Committee have access. The Inspector of North Greenland, residing at Disco, was extremely thankful for the presents of lime juice, which in the name of the Admiralty I made to him, owing to the prevalence of scurvy in his district, both amongst Europeans and Esquimaux.

46. (*Admiral Inglefield.*) Did you obtain scurvy grass, or were any arrangements made for growing mustard and cress and issuing it to the men?—I cannot speak exactly about dates, but I think that scurvy-grass was not fit to pluck in our neighbourhood until a later date than in more southern latitudes. A very considerable quantity was, however, obtained, but only subsequent to the outbreak of scurvy. A large quantity of mustard and cress was grown under the superintendence of Dr. Colan of the "Alert," and Dr. Ninnis of the "Discovery," and issued to the

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men, but not as a general issue; there was not sufficient for that on board the "Alert."

47. Why was not scurvy grass collected and used in the previous year 1875?—On our arrival at winter quarters on the 1st of October, the vegetation had long previously died off.

48. When did you commence to use the mustard and cress?—Not being a general issue, I must refer the Committee to the medical officer.

49. Was it your custom to give the men a hot midnight meal while working the ship through the ice?—All the men who were exposed, such as quartermasters and look-out men, had tea or coffee; and, had they wanted it, could have obtained meat, but not in a warm state. On such nights, when the crew generally were exposed, they also obtained an extra meal.

50. I think you have not made any reference to the issue of beer to the ship's crew. Had not the officers beer of their own private stores in greater quantities, in fact *ad libitum*, compared to the men?—In consequence of the "Valorous" accompanying the expedition to Disco, the officers could carry a private stock as far as that port, but after leaving Disco there was certainly no private stock of beer on board belonging to anyone.

51. Could you say how often beer was issued to the ship's crew?—When a cask of beer was opened it was issued with a reference to the preservation of the remainder, and an interval occurred in the issue of beer between the different casks, so that the issue of beer throughout the commission was not regular.

52. With reference to the immunity of the officers from scurvy compared to the men, was it not the case that the officers had a much greater variety of food by the use of soups, puddings, pies, &c., which it would have been impossible for the men to have had?—Speaking in general terms, the officers had very little supply of extra fruits; their stock admitted only of sardines, salmon, and such articles for use at breakfast, and therefore their food was changed to that extent, but that only. Indeed I think they had no preserved fruits, the Government supply being known previous to our leaving England to be very large.

53. To what use was the officers' private store-room applied?—Speaking of the "Alert," the store-rooms were the same as had been used whilst the ship was employed as a man-of-war; and, with the exception of wine in the spirit-room, which is usually allowed in a man-of-war, no other private stores beyond those already mentioned were carried, except, perhaps, what the officers carried in their own cabins.

54. Then I understand the officers' store-rooms were used for the ship's general use?—No, I have not stated so. The small officers' store-room was filled with their own stores, as is usual.

55. (*The Chairman.*) Proceeding to the 3rd paragraph: "I attach the greatest possible importance to the daily administration of lemon juice, to commence the day after the fresh vegetables cease on leaving England, but this must be carried out on the most rigid principles on which it was, without one day's interruption, carried out on board the "Investigator" on my representation of its absolute necessity, namely, by having the aggregate allowance of acid of one ounce per man, with a proportionate quantity of sugar and water mixed in a tub, and drunk on deck in the presence of the officers of the watch. I cannot overrate the importance that I attach to the adoption of a similar course in the present expedition, and would urge its being carried out in the strictest manner. By doing so there will be positive evidence that every man in the ship is fortified with an antiscorbutic agent of undoubted efficacy, whereas in the course usually adopted of sending the lemon juice to the several messes for consumption, there is no evidence whatever of any man taking it, and so valuable an agent should not be left to the whim or caprice of individuals, but rigidly enforced as an element of their safety." Was this recommendation strictly carried out?—The recommendation of the Medical Director-

General was strictly carried out, previous to the crews starting on the sledge expeditions the ration of lime juice was doubled, and all men returning from a sledge journey received a double allowance whilst resting on board.

56. In your letter of December 14th, 1876, I observe that you state that the second allowance of lime juice was not drunk at the tub but was sent to the messes, as you were satisfied that the men, being grateful for it, would make use of it. Can you suggest to the Committee any mode of testing the accuracy of your impression?—On the first issue of lime juice in the presence of an officer one man was discovered who could not drink lime juice, and the only mode of giving him the ration was for the medical officers to administer it at their discretion, and it was some months before they succeeded in educating his palate to receive it as an agreeable beverage, but afterwards he regarded his lime juice as a boon, the same as the rest of the ship's company.

57. (*Admiral Inglefield.*) Did the man who objected to the flavour of lime juice suffer from scurvy?—Yes. I believe his name was Francombe; he was employed in the northern division of the sledges; but notwithstanding his objection, the lime juice was administered to him the same as to any other man daily throughout the winter.

58. (*Dr. Fraser.*) I understand you to say that the recommendations of Sir Alexander Armstrong in reference to this question of lime juice were strictly followed out by you and your crews?—Yes, strictly carried out.

59. You tell us, however, that the quantity of lime juice was at a certain period doubled beyond what I understand was the recommendation of Sir Alexander Armstrong?—Yes.

60. Then I suppose that these recommendations gave you a considerable amount of discretionary power?—I considered the whole of Sir Alexander Armstrong's paper on the health of the Arctic Expedition as a suggestion and recommendation to me, but not in any way compulsory.

61. Can you give the Committee the date on which the issue of lime juice was first commenced after leaving this country?—On the 6th of June, 1875, the issue of lime juice was commenced. Up to the previous day, the ship's company were victualled on fresh beef and vegetables.

62. The allowance on commencing, I suppose, was in accordance with Sir Alexander Armstrong's recommendation, of one ounce per man daily?—The ration from the first was one ounce of lime juice and one ounce of sugar, the usual naval ration.

63. On what date did you double this ration of lime juice?—From March 1st, 1876.

64. Do I understand you to say that while the crew were taking one ounce of lime juice it was taken at the tub in the presence of the officers?—Yes, except in the case of a gale of wind or some such natural obstruction.

65. Then it was only when this ration was doubled that a portion of it was taken somewhere else; in the messes, I believe?—Only when the ration of lime juice was doubled was half the quantity issued in the evening to be consumed in the messes. I should state that to the ward-room officers lime juice was issued to them in their mess.

66. From the first?—From the first.

67. I did not quite understand your answer to the Chairman as to the reason why you departed from the previous procedure in allowing one portion to be consumed somewhere else. Have you anything further to say with reference to that?—The issue of lime juice was doubled by me, knowing that I should save lime juice to an equal extent, while the men were employed during the month of April, in the sledge journeys; it therefore left at my disposal a sufficient quantity to double the ration, and I knew that it would be agreeable to the ship's company generally; but this extra issue was never intended to be compulsory, the same as the regular issue of lemon juice.

68. Can you tell us if the double allowance was really consumed?—To the best of my belief the whole of the men drank the extra issue of lime juice, but the half issued in the evening being sent to their messes, I cannot be certain.

69. In fact you did not think it of much importance that they should take this double allowance?—Not of sufficient importance to make it compulsory.

70. You have given us the date on which you commenced this double allowance; how long anterior to the starting of the sledge parties would that be?—The general start was made on the 3rd of April. One sledge, with two officers and two men, started in the middle of March.

71. Did you double this allowance for any reason in connection with the sledge parties?—Knowing that the sledge parties would have no lime juice, although recommended by the medical officer of the ship, I gave them as large a ration as was in my power previous to their start, both as a medical precaution and as an agreeable drink to themselves.

72. Can you tell us when scurvy first appeared in connection with the expedition?—On board the "Discovery" one solitary case appeared during the winter; but no one ever dreaded any general outbreak of scurvy previous to the first week in May.

73. You had no reason to suppose that the double ration of lemon juice might itself be injurious?—I had no reason.

74. Before issuing it did you consult the medical officers?—Certainly; but, as far as I can remember, Dr. Colan considered it immaterial, except that I think he would sooner have saved the quantity expended by the increased issue, for use in case of accidents.

75. I should like to ask you if you noticed whether the extreme cold had any obvious effect upon lime juice?—Knowing that previous expeditions had had their supply of lime juice frozen, I took precautions not to submit it to the weather. No lime juice was ever frozen during our absence from England except that carried on the sledges of the northern expedition. Of course in that I am only speaking of the "Alert."

76. How was the lime juice carried or kept?—In the usual service 4-gallon jar covered with wicker-work.

77. (*Dr. Donnet.*) In the only exceptional case which you mention having occurred among the crews of a refusal to take the allowance of lime juice, did you observe any peculiarity in the temper and character of the individual so refusing; was he of a cheerful or of a retiring disposition?—Francome was a moderately cheerful man. He took part in all the weekly entertainments.

78. In doubling the allowance of lime juice to men starting for or returning from a sledge journey, was this allowance taken as a duty or as a pleasure?—The extra allowance in the evening was taken as a pleasure.

79. In issuing this double allowance were you under the impression that it would serve as a strengthener to their future efforts, and thus ward off any attack of scurvy?—I never expected any attack of scurvy to visit the expedition even had we been out three years.

80. Had you any special reason then for giving this double allowance?—None, except that my stores allowed it.

81. Do you consider the allowance of one ounce of lime juice sufficient for an expedition proceeding to the arctic seas?—The men attacked by scurvy, besides being placed on a ration of fresh meat, had three or four ounces, and perhaps more, of lime juice daily while on the sick list; but for a general issue I should consider that one ounce of lime juice was sufficient.

82. You mentioned precautions taken to prevent the freezing of the lime juice, what were these precautions?—Stowing the jars in the holds where I knew the temperature would not fall below + 28°.

83. Was any oil poured into the lime juice jars to

protect it from congelation?—It was mixed with spirit previous to its issue from the Victualling Yard. It came from Deptford. There may have been a little oil, but there was a considerable quantity of spirit.

84. Do you think that the oil was used to prevent the access of air?—I am not certain that there was any oil.

85. From your experience in both hot and cold climates, do you consider lime juice indispensable as a portion of the ration served out to the men of ships in general?—Quite indispensable.

86. Would you consider it essential as a preservative where men are well provisioned, and where sound preserved meats are supplied?—Most certainly.

87. From your observation would you say that meat and vegetables in a preserved state, without fresh meat and without lime juice, are insufficient as food to protect against an attack of scurvy?—My opinion is that preserved meat and preserved vegetables of themselves are not sufficient diet for health.

88. (*Vice-Admiral Inglefield.*) I should like to know whether you brought home a fair sample of the lime juice that was issued to the ship's company, so as to admit of its being analysed as to its present condition?—There has been a large quantity of each article used in the scale of diet returned to the Victualling Yard, and it can now be used for that purpose.

89. What quantity of fresh potatoes were supplied to the expedition?—There was no appropriate space in which to stow fresh potatoes on board the ships, and there were none carried except with the fresh vegetables on leaving England, which lasted until the 5th of June, 1875.

90. (*Dr. Fraser.*) You mentioned the quantity of potatoes which was carried, do you think it would have been impossible to have carried a larger stock?—Altogether impossible. On first leaving England, the rough weather to be expected in crossing the Atlantic, both by the ships composing the expedition and the store ship, prevents them being carried, and after leaving Disco more appropriate provisions are carried in a condensed form.

91. What provisions do you refer to as being carried in a more condensed form?—Edwards's preserved potatoes, preserved fruits, compressed vegetables, and such articles.

92. Is it within your knowledge that potatoes are sometimes carried for long periods in ships in northern latitudes?—I believe that they have never been carried by ships when pressed for stowage room.

93. Did you observe any defect in any of the articles of food which were supplied to you?—None whatever; with the exception of the salt beef; although great pains were taken to supply us with the very best meat in the market, rounds of beef of Aberdeen bullocks, for some reason, whether it was that this part of the animal takes the salt more readily than the part usually used for navy beef, the beef was both very salt and hard, and was not liked by the ship's company so much as the common meat issued in the navy.

94. Were you able to supply your crews with good water?—In this respect the "Alert" was more favoured than any vessel I know of that has wintered in the arctic regions, being able to obtain fresh water ice to melt into water instead of the usual snow, which is frequently more or less brackish. I cannot speak for the "Discovery," but from what I have heard I think they were not so favoured. In fact, the officers who visited that ship from the "Alert" in March noticed the taste of their water immediately on arrival on board the "Discovery," and informed them that their water was brackish, and informed me of the fact on their return.

95. In which ship did the outbreak of scurvy first occur?—The first solitary case of scurvy occurred on board the "Discovery." I have greater trouble in saying to what circumstance the outbreak is to be attributed on board that ship than on board the "Alert," in consequence of their ample supply of fresh musk-ox beef, which, in my opinion, ought to have kept the scurvy away.

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96. Then to what do you attribute the outbreak on board the "Alert"?—I really cannot say. Its outbreak is to me most inexplicable and unlooked for.

97. Can you inform us how you had the good fortune to obtain such good water in the "Alert"?—On the surface of the very heavy polar ice the summer thaw produces large pools, extending upwards of 20 feet each way, and from 3 feet to 6 feet in depth, which in freezing again in the early autumn leave pure fresh water ice on the top in sufficient quantities for us to dig it out during the winter without touching the salt stratum immediately below it.

98. These conditions were not present in the neighbourhood of the "Discovery"?—One of these large pieces of ice drifted into the "Discovery's" winter quarters previous to the winter's freezing, and they could only know it as an iceberg made out of fresh water glacier ice; and the upper stratum first used, being perfectly fresh, would lead them to that conclusion, and probably they may have gone down too deep into the brackish under-lying stratum on some occasions.

99. (*Dr. Donnet.*) Was this ice which you mentioned obtained during the time that you were in winter quarters, and from any water lakes in your vicinity?—We obtained water in this manner the whole time during the winter until the thaw occurred in July. After that time the water was pumped off from the shore, only 120 yards from the ship. There were no fresh water lakes on shore within a reasonable distance from the ship from which we could obtain fresh-water ice. The snow collected on the salt-water ice was very frequently found to be brackish both by ourselves while in the ship and by the sledge parties when forced to use it during the travelling journeys.

100. Was the water which was pumped off from the shore simply the result of the thawing of the snow?—The water melted from the snow that had thawed above the pool dug on the beach.

101. Though you have said that on one occasion the water obtained by the "Discovery" was not good, were you told of any bad consequence following its use?—No; I only mentioned it to show how readily the presence of the brackish water was detected by men accustomed to drink pure water; whereas its presence may not have been so detected by those long accustomed to use it. At the same time, I in no way suppose that the "Discovery" was in the habit of using this water generally.

102. How did you obtain your own water on board the "Alert" during the winter quarters?—A party of men dug it from off the raised piece of ice during the time when the moon was above the horizon; it was then carried and stacked close to the ship in order to readily carry it on board during the dark period, when a sufficient quantity could be stowed in a snow house built on deck near the top of the galley for a supply for three days.

103. What means had you for melting the snow?—A large iron reservoir built round the galley funnel, with taps leading from it on to the lower deck, and an opening on the upper deck to admit the ice; but in order not to limit the supply of water a considerable quantity was also melted in boilers over the fire; in fact, the reservoir would not have melted a sufficient quantity.

104. What time did you allow the water to stand before using it, or was it at once drinkable?—It was always at once drinkable, and was never kept.

105. Did it not taste flat?—Not in the least. The surface of the salt water ice is always covered with minute dust, which, during the summer after the thaw has set in, is always found at the bottom of the fresh water pools.

106. (*The Chairman.*) Proceeding to the fourth paragraph: "When it may become necessary to recruit men after great or unusual fatigue, either in working a ship through the ice after midnight or on long marches when travelling, I consider cocoa or tea infinitely preferable to spirits, hitherto generally given,

and I think the use of the latter should be abandoned on such occasions as far as practicable." State the result of your experience in regard to this suggestion as to which is preferable, cocoa or tea?—I should decidedly prefer tea after the regular meals of the day; but I think either would be preferable to spirits. We had a supply of coffee on board for such purposes, and it was sometimes issued instead of tea.

107. State whether you think it equal or inferior to tea or cocoa, as the case may be?—Very much the same. It so happened that while working through the ice the weather was either very calm or, when there was wind, the ship was secured to the ice; therefore there were very few occasions when any of the crew in either ship were employed with all hands on deck, which would necessitate a night issue. On long marches, when travelling, the usual supply of spirits was curtailed, and in lieu of the midday allowance a double supply of tea was carried, to enable it to be used for lunch instead.

108. (*Dr. Fraser.*) What do you mean by "the usual allowance of spirits"?—The ration that had been usual on all former arctic sledge journeys.

109. In what form was the spirit given?—It was issued in the evening, just previous to the men going to sleep, with such quantity of water as was obtainable.

110. That is in sledging expeditions?—In sledging expeditions.

111. Can you tell us what quantity was usually issued, and what description of spirit?—Half-a-gill of rum at the usual service strength, reduced from the concentrated supply, was issued on board the ships until October the 26th, when, except on days on which half-a-pint of beer was issued, which was twice a-week, a double allowance of rum was issued, until the departure of the sledge travellers on April 3rd, 1876; after which date the ration was again reduced to half-a-gill. The ration of rum for the sledging journeys was half-a-gill of the concentrated rum, which was 30.5 over proof.

112. Was rum the only form in which alcohol was given to the sledging parties?—Yes, except for those employed on hunting or natural history excursions, when, on one or two occasions, brandy was taken in lieu.

113. On board ship beer was issued, and I suppose that could not be carried in the sledges?—It would freeze until about the middle of May, and its bulk and weight would not admit of its being carried.

114. Were there many members or any members of the crew who never took spirit in any form?—On board the "Alert" there were two who never took any spirits the whole commission; and, I believe, had not done so in their life previously. There were four or five others who were more or less abstainers.

115. We have heard something of the medical history of these abstainers; can you give us any information on that point, in reference to the outbreak of scurvy, for instance?—I would prefer waiting to give very exact information until I can tabulate the exact amount of work that each man performed; but, as a rule, on board the ship, neither I nor any other officer could see that the abstainers were either better or worse than the other men. But it must be remembered that, in our case, the whole of the crew were men of very good character, who could scarcely ever have committed themselves in their long previous career in the navy.

116. (*Admiral Inglefield.*) I should like to ask, had you materials to make spruce beer on board?—No; having no Sylvester stove, the quantity of extra coal which would have been required to make the beer would have enabled us to carry a cask of Allsop's ale instead.

117. (*The Chairman.*) Proceeding now to the next paragraph: "When in winter quarters, daily exercise should be rigidly enforced on all whose duties do not require them to remain on board, and the hours between breakfast and dinner, and between dinner

and supper, should be entirely devoted to it, or to such work as may be necessary outside the ship, so as to ensure about six hours exercise during the day. The indoor workers, commonly termed "idlers," will, if permitted, evade exercise, but it should be enforced on them at periods when they are not required on board." In reference to this paragraph, had you any daily routine during the period the ship was in winter quarters, and if so produce it?—There is the winter routine for the "Alert" (*producing it*). (Appendix No. 4.)

118. (*Dr. Donnet.*) What means did you take to clean your lower deck?—The whole aim was to keep it as dry as possible, and it was more drying and sweeping up the lower deck, which was painted, than the usual service cleaning. Cocoa-nut matting was laid down in the gangways and then rolled back in the mornings, and the deck only wetted when necessary.

119. In your routine you mention that on the first Friday in every month the bedding was spread out and aired on the lower deck. Did you find this bedding wet from the condensation of the breath of the men?—Not as a rule. On two or three occasions men sleeping near a hatchway found their bedding damp, and were allowed to dry it either in the drying-room or before a stove, in addition to the Friday general drying, and, of course, on all occasions removed their sleeping billets to other parts of the ship.

120. (*The Chairman.*) In reference to the personal cleanliness of the men, did you take any special measures?—I will hand in the regulations for the use of the drying-room, which will give the whole of that information (*producing the same*). (Appendix No. 5.)

The witness withdrew.

Adjourned to to-morrow at 11 o'clock.

THURSDAY, 11TH JANUARY, 1877.

PRESENT:

ADMIRAL SIR JAMES HOPE, G.C.B., in the Chair.

ADMIRAL SIR R. COLLINSON, K.C.B.

VICE-ADMIRAL E. A. INGLEFIELD, C.B., F.R.S.

JAMES J. L. DONNET, Esq., M.D., Inspector-General of Hospitals and Fleets, R.N.

THOMAS R. FRASER, Esq., M.D., F.R.S.E.

H. J. VANSITTART NEALE, Esq., Secretary.

CAPTAIN SIR GEORGE STRONG NARES, R.N., K.C.B., F.R.S., *further examined.*

125. (*The Chairman.*) Proceeding to the 6th paragraph: "A periodical monthly examination of the ship's company, after they are settled in winter quarters, should be carried out, as the earliest signs of debility or scurvy will be readily detected thereby, and immediate measures may then be taken to arrest it." Was that recommendation carried out?—Yes.

126. In Captain Stephenson's Report, paragraph 99 (therefore, I presume, towards the end of February), he states, "but all looked pale and blanched." At your monthly inspections did you notice any change of this description in the appearance of your people?—Yes; the paleness is inseparable from arctic service, after passing a winter.

127. That being the case, you do not consider the pallor in question to be any special indication of debility?—None whatever.

128. (*Dr. Donnet.*) Do you think that the absence of the stimulating qualities of light had any effect upon the paleness and the blanched appearance of the crew?—It occasioned it.

129. Did you observe your men at the end of the arctic night, and was there any indication of the lowering of their physical powers from the absence of light?—I considered that they were paler than the crew of the "Resolute," in which ship I passed two winters in about latitude 75 degrees north, near Melville Island;

121. (*Dr. Donnet.*) In what part of the ship was your drying-room, and what means had you for keeping it dry and clean?—The "Alert" was better provided in this respect than any ship that had previously entered the arctic regions. In lieu of the general practice of the drying-room being in the holds, with an opening above communicating with the living deck, the drying-room was bulkheaded off from the lower deck in the fore part of the ship, heated by a special stove of its own. The hatchway above, through which the condensation escaped, communicated with a large snow chamber built under the forecabin. The room was cleaned up every morning previous to divisions.

122. (*The Chairman.*) Each mess having a washing day once a fortnight for ablutionary purposes, was any special measure taken to ensure that the men individually availed themselves of it properly?—If they did not use the washing-room, they would have been on the ice working with the working-party, which would not to them be preferable to washing clothes, or they would have been idling about the lower deck and been detected; but they were not actually mustered into the washing-room by any one. In addition to having the forenoon allowed them once a fortnight for washing clothes, Saturday was also used by most of the ship's company for ablutionary purposes.

123. Had they the means of bathing?—Large tubs, the usual service tubs.

124. Were there any special regulations in regard to change of clothing?—No; merely the daily inspection by the officers at divisions.

but I cannot speak with regard to their physical strength, for at that time of the year there are no means of judging of the stamina of the men. The chief tax on the crew in the early spring is occasioned by the walking parties preparatory to the sledge expeditions; and with the exception of one or two weakly men, they used to return after their exercise in what I considered was much the same state as had been experienced in former expeditions.

130. The experiments made by the officers of the expedition upon the growth of the seeds of mustard and cress in darkness showed, that the absence of light had a deteriorating effect upon the growth and appearance of these plants. Do you not think that the men's constitutions were influenced by a similar deteriorating effect as that caused by this absence of light upon the appearance of these plants?—All the mustard and cress that has ever been raised during an arctic winter has an absence of the usual green appearance; it appears of a very light yellow, and has no other colour. As far as the useful properties of the plant are concerned I cannot give exact information, but I believe it has lost some part of its useful properties.

131. On the reappearance of the sun were you able to have light admitted below?—The whole question of lighting the living deck of an arctic ship is a most

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important and difficult one. In consequence of the coldness of the atmosphere, it was not possible to remove the snow from the skylights till early in May, when I find the following remark in my journal, on the 12th of May: "I have uncovered every skylight leading below, to let as much light into the ship as possible; still the lower deck is very dark in parts. This must be attended to in future arctic ships." That would be a few days after the scurvy had broken out. I also find that on April the 29th all the snow on the upper deck above the bull's-eyes was taken off, and the quotation in my journal is: "Still the lower deck is perfectly dark. This is a very great disadvantage. Besides expending candles, it is gloomy work living in the dark with the sun so bright for the whole twenty-four hours, that while on deck we are obliged to wear dark spectacles. Constant living in the dark for the few sick men left on board must be very bad for their health."

132. How many days of darkness had you on board the "Alert," and how many on board the "Discovery"?—The sun centre was below the southern horizon for 142 days at the "Alert's" winter quarters; at the "Discovery's" I think for 138 days.

133. Can you tell me how many cases of scurvy were under treatment on board the "Alert," and how many on board the "Discovery" during the commission?—Thirty-six of the crew of the "Alert" were under treatment for scurvy. I cannot state the whole number on board the "Discovery," but in consequence of the early return of their western sledge party, many of their crew were not engaged in such hard sledge travelling as the crew of the "Alert," and the number of scurvy patients was less.

134. I believe that sixteen men of the "Discovery" were affected with scurvy; six of these had wintered in the "Alert." The larger proportion of scurvy cases appeared to coincide with the greater proportion of days' absence of light. May not some importance be attached to this fact, and may not this absence of the genial influences of light have predisposed to the evil effects which ensued?—I think the absence of light may help to produce scurvy, but not necessarily so, and the four days' difference between the darkness experienced by the "Alert" and that by the "Discovery" should not be considered at all.

135. I would wish to put the following question to you, which, though a speculative one, has some bearing upon the subject of the present inquiry. Supposing that you had taken up your quarters in Port Foulke (the "Elysium of the arctic regions," as you have termed it), have you not reason to believe, from the greater number of days of light they would have enjoyed, the less fierce cold they would have experienced, and the greater amount of large game they would have killed, that the men would have been rendered more fitted for their spring travelling duties?—The fewer number of days of darkness would certainly have been less disadvantageous to health. The greater cold experienced by the late Arctic Expedition I do not think distressed the men in any way except so far as they experienced it whilst absent on the sledge parties; but even then former sledge travellers had experienced the same low temperature as our men did. The fresh meat which can at Port Foulke be obtained in great abundance, would most decidedly be very beneficial; but from that position as a base it would have been scarcely possible even to have attained to the latitude of the "Alert's" winter quarters by sledges. It would certainly have been impossible to have attained so high a latitude or explored the same amount of coast line as our sledges were enabled to do by wintering where we did.

136. (*Admiral Collinson.*) Would you furnish a return showing the period of total darkness and of the return of light?—I can readily furnish a diagram explaining the exact amount of darkness experienced by the late expedition, and a comparison with that experienced by all former arctic expeditions that have wintered inside the arctic circle. (Appendix No. 6.)

137. Is the great discrepancy between the number of men attacked with scurvy in the "Alert" and in the "Discovery" in your opinion owing to the greater amount of labour undergone by the crew under your command than by those under Captain Stephenson's command?—I consider that had there been no sledge travelling there would have been, comparatively speaking, no cases of scurvy in the doctor's hands. The severer the labour the crew underwent the more severe were the cases of scurvy; and a greater number of men belonging to the "Alert" were employed in the sledges which met with the hardest work.

138. Do you attribute the greater immunity from scurvy enjoyed by the "Discovery's" ship's company in any way to the fact that they had more fresh provisions (musk ox, for instance) than your ship's company had?—Most certainly. In every case of scurvy that occurred, immediately the patient received a ration of fresh food and lime juice combined, a marked appearance for the better was observed even by the officers not experienced in those matters, and the whole attack very readily yielded to the fresh meat and lime juice diet.

139. (*Admiral Inglefield.*) From your experience on former arctic voyages, do you think that if the crews of the ships had been acclimatised by an arctic winter, unaccompanied by the extreme exertions that your crews underwent during their first experiences of an arctic climate, that would have been the means of keeping the crews in better health, and preventing the outbreak of scurvy?—I consider that there is no such thing as acclimatising a European in the arctic regions. In every one of the expeditions which have passed more than one winter in the arctic regions, the crew and officers have been far more sickly the second year than the first; and on board the "Resolute," in 1852, where nearly the whole of the crew of the "Investigator" were berthed as well as our own, it being our second winter, and the "Investigator's" fourth, there was a very marked difference noticed by every one, medical men and the other officers, in regard to the difference of the stamina of the two crews, although the "Resolute's" crew was being fed on preserved meat, and the usual rations, and all the fresh meat, was being used by the "Investigator's." At the same time, on arrival at Beechy Island, the crew of the "Resolute," so far as the medical returns appear, were nearly as greatly distressed after their two winters as the "Investigator's" were after their four. The crew of the "Investigator" were certainly, according to the medical returns, so far as scurvy is concerned, in better health after their fourth winter than they were after their third.

140. And does not that seem to imply that a process of acclimatisation may take place when not accompanied with extreme fatigue?—The experience of the "Investigator" was a very peculiar one. When they were so severely attacked by scurvy, they had been on only two-thirds provisions for certainly more than twelve months; and the depressing effect of the position of the ship on the crew, and the many anxieties that they were undergoing, make their case one that has never been paralleled by any one else.

141. Have you had any conversation with the Danes at any of the settlements on the coast of Greenland, with regard to this question of acclimatisation?—Never in a pointed way. In general conversation I may have spoken about it.

142. Had not the crew of the "Investigator" a great deal of fresh meat?—Not nearly so much as that obtained by the crew of the "Resolute."

143. Are you aware that in Lieutenant Payer's account of his recent voyage, several men had scurvy the first winter and spring when drifting in the floe, and they did not sledge, and at the end of the second winter and the spring following there does not seem to have been much in spite of the sledging, but the ship was off land, and in both cases they had bears' flesh, a proof of acclimatisation?—All such cases

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require a very close study. I have not yet studied the case of the Austrian expedition, but I think it will be found that the scurvy mentioned as breaking out early in the voyage was only in the case of a few of the ship's company, and certainly very few were able to go sledging at all in the second year; and I shall not be surprised to find that more men were debilitated and unfit for travelling the second year than would have been the case if they had had an opportunity of performing the same work the first year; but their sledging, for hard work, and the number of days' absence from the ship, cannot be compared in any way with the same work undergone by English expeditions, the Austrians being only absent from their ships about 30 days.

144. To what do you attribute the severity with which your men were attacked in comparison with that of the men of previous expeditions, in which long sledge journeys were performed under very similar circumstances, with the exception of the length of the night, and the greater difficulty in drawing the sledge over the ice?—I am bound to consider that the greater difficulties mentioned must have had some part to play in the outbreak that occurred; greater weights had been dragged on previous occasions, but not over such rough and heavy roads.

145. Then you have no other cause to which you can attribute the outbreak of scurvy to the extent recorded?—It is to me even yet inexplicable.

146. (*Dr. Fraser.*) You have told the Committee that the skylights of the "Alert" were opened and light admitted into the ship on the 12th of May, and that a few days previously some cases of scurvy occurred. You do not think that the prolonged absence of light can account for these cases?—Most of the few men that had been attacked previously to the 12th of May had been employed sledging, and in the light constantly day and night; and all, unless they were in the sick list, must have been on deck a considerable portion of the day. The number of days of darkness on the lower deck of the "Alert" would not be greater or less than that experienced by expeditions wintering farther south. The snow would be removed off the skylights at about the same date anywhere in the arctic region.

147. What was the number of cases previously to the 12th of May?—On the 3rd, five men were reported to have scorbutic symptoms, and one other, John Simmons, was recommended to have a double allowance of lime juice. On the 8th, eight men had a double allowance of lime juice. Four of the men attacked with scurvy on the 3rd had been travelling, and one had not.

148. The four who had been travelling were, therefore, not attacked on board ship?—James Berrie returned from travelling after about a week, very much broken down. James Hunt, the ward-room cook, was attacked immediately he came on board. Niels Petersen was also attacked on board, whilst suffering from a severe case of frost-bite; Berrie had been ill during the winter, and Hunt, who was engaged as ward-room cook, would be a very liable man to experience an attack of scurvy if it broke out amongst the crew. Also V. Dominique, the ship's cook, who was only away three or four days, and was then attacked with scurvy, would be a very liable case.

149. How was the one man who had not been travelling employed at the time or immediately anterior to his being affected with scurvy?—The only man who had not been travelling and was attacked with scurvy was G. Burroughs, the ship's steward, who had been severely ill for about a month previously. I may also add, that Petersen was over our standard of age, and had passed several years previously in the arctic regions on the coast of Greenland.

150. Do you consider that the four men who had been travelling had undergone very severe fatigue and hardship?—Being all weakly men, they probably felt the hardships more than their sledge mates.

151. Could you give us an idea of the kind and amount of work done by these four men during this travelling, and anterior to the appearance of scurvy?—Dominique and Hunt were attached to a sledge pulling less than 200 pounds a man, being known not to be so strong as the regular crew. Berrie was captain of one of the sledges, dragging about 240 pounds, the recognised arctic weight. Petersen was attached to the dog-sledge, and only had to exert his strength in the bad parts of the road. But the dog-sledge work is always felt by the men employed in it to be really more severe, or as severe, as the work with the man sledges.

152. How many days was each of these men so employed?—From five to seven days, but I cannot speak to a day. Petersen was only one day absent from the ship at work.

153. Judging from the amount of work which these men performed in the periods you have mentioned, do you think that within those periods they were subjected to exertion greatly beyond their capability?—I consider that the disease must have been in them previous to starting on the sledge expedition, but it was brought out immediately by the hard work, which, although the men had been exercised as much as possible, was, and always must be, a sudden change in the mode of life, and a tax upon their strength after the quiet of the winter.

154. Restricting your attention, however, merely to the amount of work which these men performed during the periods which have been mentioned, do you think that that amount of work was in itself sufficient to have produced scurvy?—Certainly not, unless the men were predisposed.

155. You say that, in your opinion, the disease must have been in these men previously to their starting on the travelling expeditions, what are your grounds for that opinion?—I should not have formed that opinion if only a few men had been attacked, but when every man employed on the severe work was ultimately attacked, I now consider that there must have been some predisposing cause. In previous arctic sledge journeys, although the road was smoother, the distance travelled daily must really have taxed the strength of those men equally as much as it did ours; and with regard to this question, I can only find this difference between our parties and former ones. In consequence of our very calm weather no one sledge was ever delayed by bad weather for a single hour; but in all previous sledge journeys, within a week of leaving the ship during the cold season, halts had been necessary in consequence of bad weather, sometimes to the extent of from three to four days at a time, and, however distressing these halts were to the crews at the time, I believe now that they contributed greatly to the health of the men, more particularly in giving them a few days' rest, although painful and cramped up, after three or four days, when they were being broken into the work. The sledge parties in previous expeditions, which can be compared best with ours, with regard to the absence of fresh food, are those that were under the command of the present Admiral Ommanney. In his sledge expedition he was forced to encamp for no less than 15 days, during which time the men were resting. Out of our crews those men who obtained rest by returning to the ship occasionally were not attacked so severely as the ones long absent. But that leads me to state that, in our case, had a rest been forced on any one of the distant sledges, after the outbreak had grasped them, it would have been fatal; for in our case had any man once rested he could never have used his limbs again.

156. I wish, however, still to ask you to consider the case of the first outbreak in these four men. The opinion which you have expressed, that the disease was in them previously to their starting on the travelling expeditions was, as I understand you, an opinion which you afterwards arrived at from what you have learned of the history of the outbreak of scurvy

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during your commission?—I am speaking now by my present knowledge.

157. I suppose that these four men were subjected to a medical examination before they started on the travelling expedition that we are now talking about?—Yes, they were reported healthy men; but the men that had been employed at the galley between decks during the winter were naturally sent on the shortest journey.

158. In fact, in your opinion, and in that of the medical gentlemen who examined these men, they were quite able to undertake comparatively short journeys of from five to eight days, and at the time they started there was no suspicion or evidence of the presence of scurvy in them?—They were considered perfectly able to undergo the work, so far as any man ever can be, and there was not the slightest suspicion at that date of any one on board the ship having scorbutic symptoms, with perhaps the exception of the ship's steward, who had been ill a long time.

159. During this travelling, I understand, the dietaries were necessarily changed from that on which the men subsisted on board ship?—Very considerably.

160. We have here the diet list for your sledge parties; may we take it for granted that this list represents the dietary served to these four men during the travelling?—Yes.

161. In your opinion is this diet list a sufficient one for men employed as these four men were employed during five or eight days?—On first starting they could not possibly have eaten it to the full extent; but what is saved in the early part of the journey is used as an extra ration later. But after thirty or forty days' arctic travelling it is difficult to obtain as much food as the travellers could consume.

162. In fact the solid articles of diet were somewhat in excess at first?—For the first two days they were in excess.

163. In your opinion, therefore, the total quantity of food represented by such a dietary is ample for men employed as these four men were during five or eight days?—So far as an arctic ration for consumption, with a temperature of from 30 degrees to 40 degrees below zero can be; if it is sufficient to keep men in health anywhere it would also keep men in health in the arctic regions.

164. In reference to the antiscorbutics represented in this sledge dietary, do you consider that they differ in any important respects from the antiscorbutics represented in the dietary used by the men on board ship?—The diet is totally different. On board ship half the allowance of meat issued is salt meat; on a sledge party the one pound of pemmican allowed daily is fresh preserved meat, and the four ounces of bacon is only slightly salted. On board the ship a ration of lime juice was issued; with the sledge parties working in the cold weather no lime juice was included in the rations, and the other antiscorbutics, such as cabbage and preserved fruits, could not possibly be cooked while travelling. The onion and curry powder is an extra ration used while sledging, which is not used on board the ship, and forms a very important article of diet.

165. Looking at your arctic sledge diet list, can you point out which of the substances mentioned in that list are in your opinion antiscorbutics?—I consider all good food an anti scorbutic, and that no one article of diet can be used separately when men are undergoing severe labour.

166. Although no one article of food will maintain health, you are of course aware that a certain amount of judgment must be exercised as the result of experience in the combination of articles?—That is what I allude to. The present scale of sledging diet has been drawn up after great experience, and after many very successful lengthy journeys had been performed on that diet; and the only outbreak which has ever occurred similar to ours was in the expedition commanded by Sir James Ross, when on the usual ration that was allowed on board ship, namely, salt and

preserved meat alternately, and an allowance of lime juice, the crew returned after an absence of 40 days, just able to struggle on board in the same manner that our men were.

167. Returning again more especially to the cases of these four men, I observe that in the dietary which we have learned was supplied to them during their five or eight days' travelling, one antiscorbutic, namely lime juice, which is represented in the dietary served to the same men on board ship, is absent: does this represent the fact?—They were not supplied with lime juice while absent from the ship, but also they did not consume during that time any salt meat whatever.

168. (*The Chairman.*) With reference to the sledge party belonging to Sir James Ross's expedition, which you state was absent 40 days, did their diet consist of the ordinary ship's rations, or had they a sledge diet?—The ration is not actually published, but I presume it can be obtained.

169. Omitting now the 7th, 8th, 9th and 10th paragraphs, we will proceed to the 11th, the subject of which is connected with that which we have been considering: "The use of lemon juice, when travelling, should be enforced in the same manner as already recommended for the men on board the ship." Was that carried into effect?—No.

170. (*Dr. Fraser.*) Can you state to the Committee why it was not carried into effect?—The impossibility of using the lime juice without a total change in the equipment of a sledge party, and knowing that on very many occasions previously no ill effects had arisen from the use of the diet which I chose.

171. Can you tell us what inconvenience to the equipment of the sledging parties it would have caused to carry the necessary quantity of lime juice?—The extra time that would be occupied to thaw the water necessary, and the extra weight of the ration which would necessitate a reduction of three days' provisions out of the forty-two that are generally carried, and also the difficulty that there would be in extracting the frozen lime juice from the bottle in which it would be obliged to be carried.

172. With the heating appliance at the command of the sledging parties, can you give the Committee an idea as to how long would be spent on each occasion that an issue of lime juice was made, in thawing the lime juice?—To melt sufficient snow for each man to have sufficient water to mix with his lime juice, besides the trouble of thawing the lime juice itself, would occupy, when the temperature was -30° , about three-quarters of an hour; that is, without considering the time for trimming the lamp and re-packing the sledge.

173. I suppose the sledge would require to be repacked at any rate if the issue were made at a time when there was a halt?—Yes; but at those times the tea already issued is sufficient to quench the men's thirst.

174. How long is occupied in trimming the lamp, do you think?—The lamp would certainly take another half-an-hour in trimming and in waiting for the stearine to freeze solid again, which would be necessary before starting the sledge over a rough road. On smooth roads further south, I have frequently melted water on the sledge whilst it was proceeding on the journey.

175. Are these facts the result of observation or your personal experience, or are they inferences?—From my own personal experience.

176. How many lamps were usually carried in a sledge?—Two; a spirit lamp and a stearine lamp.

177. Were they usually both in use together?—No. To keep the weights down as much as possible only one cooking apparatus is carried. The stearine is preferred generally for fuel, but in consequence of its being dangerous to leave it in depôt at the mercy of animals, the spirit is usually left in depôt and used during the return journey. But on former arctic journeys some sledge crews had been supplied with two apparatuses, and they had used spirits of wine to

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lessen the time of the halt, when it was necessary to have as short a halt as possible.

178. Then one lamp was generally sufficient for every purpose on each halt?—It would not be sufficient if lime juice were to be carried, which I consider now to be an essential article of sledging diet.

179. Therefore, if you had entertained the same opinion before arranging the equipment of the sledges, you would, no doubt, have succeeded in making arrangements whereby you could have supplied sufficient heating power for thawing rations of lime juice?—In making these arrangements I should have so totally altered the whole system of arctic travelling that I need not have started off the men until a warmer time of the season, and then the whole question is changed completely. With the increased cooking necessary I think it would be a very severe tax upon the men if they were further exposed in the cold weather to a longer halt than was necessary formerly. I may state that after our late experience, except in the case where sledging parties are employed in an endeavour to save life, I do not think the men should be taxed to such an extent as they have been; and I would, therefore, on a future occasion only arrange for the men to be absent for about sixty days, which would enable a total change to be made in both the diet and the whole system of travelling.

180. It being your opinion, as I have understood you to say, that lime juice is an essential article of the dietaries in sledging, amongst those changes which you would in future make, I have no doubt you would include lime juice as one of the articles in the dietary?—Yes; and if necessary I would issue it in lieu of the evening tea.

181. Tea is greatly appreciated, I understand, by the men engaged in sledging?—Very much so; but all men that have ever been employed in arctic travelling have had a craving for lime juice also.

182. I observe that in the dietary, which I understand has been prepared by you, and which we have now been talking of, there is included a quantity of rum, half-a-gill daily. Was this rum consumed by the men employed in the sledging parties?—Yes, generally before any attack presented itself, when the rum was immediately stopped by the officer in command, and either used as fuel or left behind in dépôt. A considerable portion of the allowance was left behind in this way.

183. It was unnecessary, therefore, to have carried all this rum?—It proved to be so.

184. Lime juice might therefore, to some extent, even in the dietary which we have before us, have been substituted for more or less of this rum?—Certainly not. The lime juice requires much more water to mix with it, and requires sugar, and it is very frequently for want of water mixed with the tea.

185. I understood you to say that one of the reasons why you did not adopt the recommendation of the Medical Director-General, which we are now discussing, was on account of the extra weight that would have been required. By diminishing the quantity of rum or reducing it to a very small quantity, would not some weight have been gained?—The rum for forty-two days, for eight men, weighed 42 lbs., and if lime juice were substituted for it, it would weigh about the same.

186. Then, if rum had been altogether removed from the equipment of the sledges, lime juice might have been carried in the quantity which you have named without increasing the weight to be carried by the sledging parties?—Certainly, so far as weight is concerned. I cannot speak from experience as to the extent of the breakage of the lime juice bottles which would be occasioned; but I know that it has very frequently occurred, and that the little lime juice that has been carried has been lost in a certain proportion.

187. We have heard that in the "Alert" there was a very much larger number of cases of scurvy than in the "Discovery"; was the crew of the "Alert" absent

to a greater extent from the ship than the crew of the "Discovery"?—One main party from the "Discovery," employing twenty officers and men, in consequence of discovering the termination of Lady Franklin Sound, returned to their ship at an early date, and after only a few days of laborious travelling, and then had a good rest before being engaged on other short journeys, leaving only twenty-seven men of the "Discovery" to be considered, probably only twenty-two of them were employed on the North Greenland coast, and only fourteen in the distant journeys; whereas about twenty-four men were employed out of the "Alert's" crew on distant journeys. With the exception of the occasional rests on board, the crews of both ships were equally employed during the whole of the travelling season from early April to the end of June.

188. (Dr. Donnet.) You mentioned the amount of fuel consumed, and the extra time taken, and the extra weights added; might not the fuel used for thawing snow and making tea have served for thawing the lime juice?—Only just that quantity of water is formed which is necessary at the time.

189. As water is required for the making of tea, might not the lime juice have been mixed with this tea, and by adding the double allowance of sugar have made this beverage a pleasant and a necessary one?—Certainly, if it should prove to be a pleasant beverage, and if we could get over the difficulty of the actual carriage of the lime juice in its present state.

190. With regard to this addition to the weights of the sledges, is there not some article which might be dispensed with, and might not some precaution be taken to prevent the breaking of the jars of lime juice?—In preparing an arctic sledge its equipment is calculated to the very last ounce, and any alteration that can possibly be made now, must be either in addition to our present weights, or by the substitution of a new article for something formerly carried.

191. Do you consider spirits indispensable in an arctic sledge journey?—Not more so than elsewhere.

192. In your own experience have you not found a preference made in favour of tea, inasmuch as spirit, although having an invigorating effect upon the system, possesses an effect less lasting than that produced by tea?—I cannot state fully the different effect of tea and spirits, but knowing from my former experience that the men, one and all, considerably preferred tea to spirits on the last expedition, I doubled the allowance of tea, and contracted the allowance of spirits, and one and all were in favour of the change, and have reported upon it since their return. I personally am also in favour of the change, but the necessary halt that it occasioned for an hour and an half in the middle of a journey daily, was, I am sure, a very severe tax on the men, which was not suffered by the crews of former expeditions, who never halted for more than half an hour, and, in fact, proceeded on the afternoon journey after the allowance of spirit without the men getting cold by the halt.

193. Was a glass of spirits taken during this halt?—The halt was for luncheon, when half-a-gill of reduced rum was drunk with what little water was obtainable, but more frequently, in consequence of the want of water, drunk in its raw state.

194. Was tea taken at the same time with the spirits?—The ration of tea admitted of a supply only in the evening, when I personally used to mix my evening ration of rum in it; but those who did not do so could seldom obtain water to mix with it, and it was more frequently drunk raw. I may here state that all these remarks have reference only to the cold travelling during the month of April, and the first ten or twelve days of May.

195. Can you state from personal experience that spirits from their stimulating effects, may for a time resist the depressing influence of cold, but when this stimulus has subsided the cold acts with greater severity?—The change has been most marked, whereas in former journeys after their ration of rum the men

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always complained of weariness and cold in the afternoon, our men, after the ration of tea, have been unanimous in their opinion that they could work harder and for a longer period after their luncheon than before.

196. Do you attribute those bad effects to the spirits taken at the luncheon?—I can only compare the effects of the two; I myself used to feel weary after the luncheon on rum, and I certainly was invigorated by the luncheon on tea.

197. In your own person you would give the preference to tea?—I most certainly would, except on account of the long halt which it renders necessary, which is a very serious consideration.

198. What is the special inconvenience that arises from a halt?—After a halt of perhaps a quarter of an hour to twenty minutes the cold is felt very severely, and the men are obliged to walk up and down to keep themselves at all warm; the labour of dragging the sledge being sufficient to make them perspire very freely, but while merely walking they cannot keep themselves warm.

199. Do you travel by night or by day?—We travel by day as long as the sun will allow us to, but immediately it is high enough to produce snow blindness, then a change is made to night travelling; and at about the same season a change is also of advantage by the sun being high enough during the halt at noon to dry up the wet foot gear while the travellers are sleeping.

200. Although there have been some sledge parties which have been able to effect an amount of work in the arctic seas without any provision of lime juice, returning to their ship without having had any scorbutic symptoms, the universal opinion of those who have given thought to the subject is, that it is an essential in arctic service to ward off an outbreak of scurvy; is it not, in your opinion, a matter of moment to do away, in all future arctic travelling, with the ration of spirits, and in its stead to substitute that of lime juice?—I would certainly not do away with the present small ration of spirit, although I would recommend a ration of lime juice. But there would be no necessity for doing away with any of the present scale of diet if sledge parties were only to be absent from their ship during the months of May and June, that is, for about sixty days. If it is necessary to employ a sledge in the very cold weather, during the early spring, then those men should not be employed up to the end of June, and they could afford to carry their lime juice ration if the other disadvantages connected with its thawing could be done away with.

201. I understood you to say that there was a craving for lime juice amongst the men travelling; do you not consider this a proof of a want in the system for this article?—Certainly. I think that the extra craving which we all had proved that its use was beneficial.

202. With regard to the late travelling which you mentioned, would it have been safe to start men off on the pick of ice when there was more chance of the ice breaking up?—The limit of the season for sledge travelling is governed by the date of the thaw, not by the movement of the ice, except in peculiar parts. The thaw commences between the middle and the end of June, by which time all the men should be on board or in a position where they can rest for that week. Then afterwards, in July, there is very little trouble beyond the wetting of the feet that is occasioned, but this, again, has always had bad effects on the travellers.

203. (*Admiral Inglefield.*) In what way did the victualling of your sledge parties differ from that of previous travellers, say those of M'Clintock and the late Lieutenant Meham, both of whom I believe made the longest recorded journeys with a sledge in the searching expeditions for Sir John Franklin?—The first sledge journey was undertaken by the late Sir Edward Parry. I cannot state the ration that was employed in 1821; but he started on the 1st of June, returning on the 15th: after having experienced an outbreak of scurvy on board the ship during the winter he mentions travelling with no lime juice

whatever. I see he carried 1 lb. of bread and two-thirds of a pound of preserved meat. In 1822 there were a few short journeys, but in that expedition no salt meat whatever was supplied to the expedition; but owing to the very sudden outbreak of scurvy at the end of his second summer, he was forced to return to England, against his previous intentions. In his third voyage, from Spitzbergen towards the North Pole, no mention is made of carrying lime juice, but the whole of his party returned debilitated after an absence of sixty-one days, and mention is made of their gladness at finding lime juice at Table Island depôt, the first land they struck. The next long journey was Sir James Ross's, 1848–49, when, starting on the 15th May, the sledge parties returned, after thirty-seven days. I cannot state exactly upon what rations, but lime juice was carried; they experienced, however, a similar outbreak to ours. The next published accounts are those of the expedition under Sir Horatio Austin, when a quarter of an ounce of lime juice was intended to be carried, but whether it was used during the month of April I cannot now ascertain, but certainly a certain quantity of it was left in depôt, where it would not have been left had it been capable of being used during the month of April. The same year the south part of Wellington Channel was explored by the officers and men under the command of Captain Penny, using naval provisions, although in consultation with Captain Austin, he did not carry lime juice on any of the sledges. The next expedition was under Admiral Sir Richard Collinson, when I know that the "Investigator's" sledge parties were not supplied with lime juice; after that I come to my own experience on board the "Resolute," employed in Sir Edward Belcher's expedition, during which time the sledge parties were constantly at work for the first and second seasons, and the powers of the men were very severely taxed. The ration used then was precisely similar to the one adopted by myself, and in fact led to its adoption. The crews generally returned fit for work after perhaps two or three days' rest; and when the late expedition started from England it was not generally known that the men who had been employed on sledging journeys and with similar rations to ours had been very severely taxed with regard to their health. But after a careful comparison now, I may state that I am certain that all were very severely attacked, and that what is reported in the official papers as being an attack of debility was most decidedly the same as our attack by a more advanced form of scurvy, and had our men returned after about thirty days' travelling we should probably have officially reported that merely a slight attack of debility had been experienced.

204. Then I gather from your reply that you took the rations adopted by M'Clintock and Meham to regulate your own supplies to the sledge expeditions dispatched under your orders?—They are precisely similar to the rations used by those two officers.

205. (*Admiral Collinson.*) Did Sir Leopold M'Clintock provide you with a slight modification of the equipments rendered to you in consequence of the introduction of stearine as a fuel, which was not known before?—Stearine was used throughout Sir Edward Belcher's expedition. That supplied to the late arctic expedition was prepared under the direction of Sir Leopold M'Clintock; and he may have altered the ingredients for its formation somewhat, but not to my knowledge; and the same quantity of the article with which we were supplied for cooking was necessary on former occasions; and, therefore, I conclude that we had the same article to all intents and purposes.

206. Did Sir Leopold M'Clintock give you a list of the sledge equipments which he thought would be best for you to adopt?—Merely privately; he had nothing whatever to do with the responsibility of the ration used on my sledges.

207. You did not recognise that document, then, as a public one?—Most certainly not.

208. Can you inform the Committee now whether that recommendation of Sir Leopold M'Clintock's to you differed very much from the one which you yourself adopted?—I have not got it with me now, but there can be very little difference with regard to the rations used; and I think the only alteration which I have made in the equipment was in a slight increase to the tent in order to shelter the cook whilst cooking the provisions; and this necessitated an extra weight of about 5 or 6 pounds to be carried on the sledges. The double allowance of tea was a new thing adopted; but except that, I think there is no change.

209. There was no material alteration between the equipments of the sledges in which M'Clintock's and Meham's travelling parties went and yours?—No material difference whatever.

210. Can you supply the Committee with the equipment of the sledges and the weights of each article?—The official journal prepared by the officers in charge of the sledges will furnish these details. They have all been sent into office, and, I believe, are now being printed.

211. Were the men weighed before they started and on their return?—I believe not. I must inform you that you have not got the chief journals, in which you can get the whole story of the scurvy. You have got the letter reports, and you have got Markham's northern journey, which goes into details but those of the western party, under Lieutenant Aldrich, and the north-eastern Greenland party, under Lieutenant Beaumont, have not yet been issued to you.

212. In your answer with respect to the carrying of the lime juice, that it would be about the same weight as the rum, have you included the sugar that it would be necessary to take with it?—The allowance of rum for each man weighs two ounces a day. The allowance of lime juice would be one ounce, and the allowance of sugar for the lime juice would be one ounce, making the two articles exactly the same weight.

213. (*The Chairman.*) You were quite sensible of the value of the lime juice, could it have been carried?—Yes, if it could be carried and used during the cold weather.

214. And the question was of course very seriously considered by you?—I was going to answer that it was also considered by me in a medical point of view, and as being recommended by the medical officer of the ship.

215. Returning now to the 7th paragraph: "The necessity of keeping the atmosphere of the lower deck as pure as circumstances will permit is obvious, and the escape of foul air should be promoted to the greatest extent possible, and the maintenance of as much warmth and dryness as possible is most essential." Referring to this recommendation, Captain Stephenson states in his report, paragraph 36, that it was necessary to stow the hammocks in the hold, having found that stowage on deck rendered them damp when taken below. What was your practice in this respect, and what was the result?—All former expeditions have experienced a similar trouble. The hammocks are always stowed on deck up to as late a period as possible in the autumn. When the temperature falls, the cold hammock, on being brought below into the warm atmosphere of the lower deck, becomes moist, and the bedding is wet; consequently during the winter, or when the temperature is at all below zero, the hammocks are necessarily stowed in some part of the ship below in order to preserve them dry. The hammocks on board the "Alert" were stowed in the extreme forward part of the lower deck before the men's messes. After they were thus stowed, the bedding remained dry, excepting in the sleeping berth close to the hatchway, where, by receiving the cold air descending, the bedding became damp in a similar manner to what would have happened if the hammock had been brought down itself out of the cold.

216. Further, from the paragraph at page 18 of your own report, under the head of "Health," and paragraphs 35 and 37 of Captain Stephenson's report, it would appear that absolute dryness was not obtained on the lower deck. State to what extent this defect existed?—The ventilation of arctic ships is a peculiarity which can only be grasped by experience, and never yet has it been found possible to keep the lower deck beams thoroughly dry. I am certain that on board the "Alert" we succeeded in keeping the living deck less damp than on board the "Resolute" in 1852. This was partly owing to my former experience, and partly, also, to the increased experience of Sir Leopold M'Clintock in the late voyage of the "Fox," where extra houses were built on the upper deck at the head of each hatchway. These houses I increased to a large size, and the alteration was very beneficial. Without finding fault with the ventilation of the "Discovery," it was natural that inexperienced officers should not succeed to the same extent as I did; but even with our better fittings, and a far larger area per man than, I think, had ever before been experienced, the lower deck beams had to be very frequently sponged down; but we succeeded in preventing much actual drip on to the floor of the deck except, perhaps, for a quarter of an hour or so when the steam from the galley at meal times produced extra moisture. The officers' cabins were as usual the dampest parts of the ship, and it was necessary, as it always is, for an upper covering to be spread under the beams over the bed to catch the occasional drip. I was very glad to be able to reduce the number of men wintering on board the "Discovery" by eight men, in consequence of her much smaller lower deck; and I should state that when the temperature fell to a very low state, even on board the "Alert," without using a very large supply of coal, it was found impossible to prevent the drip off the beams completely.

217. Describe the mode of heating adopted on board the "Alert"?—In lieu of the Sylvester stove, which had been used previously, a number of stoves were distributed about the deck, and were used as required, sometimes all together. This was certainly a good way of both drying and warming the habitable deck, because it was found quite unnecessary to warm the holds below, in consequence of the ship wintering with water under her bottom; but had we unluckily had a layer of ice underneath the ship, we should probably have been put to great straits. On board the "Discovery," a small stove fitted with hot water pipes, which had been tried on Sir George Back's voyage to a larger extent, but had there failed through the small pipes leaking, answered admirably, it burnt the ashes from the other stove and gave out a very large warming power; and I think that had a stove been supplied which was made for us by the same maker, but which unfortunately was too heavy, a great advantage would have been gained over the common service stove; in fact I think all stoves could now be fitted with hot water pipes. The number of funnels from the stoves were of great use when turned into ventilators. The great difficulty is to produce uptakes, all openings wherever formed always being downtakes; and all the openings that I made were obliged to be closed up again, except the openings close to the beams in each stove funnelling, which always from the first remained uptakes, and were the only uptakes in the ship.

218. Of what description were the stoves in the "Alert"?—The common service stove, with the door cut in half and formed into two.

219. Vertically or horizontally?—Horizontally.

220. How was the funnelling led?—It acted better as a ventilator when led up direct from the fire, but we gained warmth by leading it up for a distance of 10 or 12 feet from the fire; a greater distance than this proved to be bad for the draught.

221. Are you acquainted with the mode of heating adopted on board the "Assistance" and "Resolute" in 1850-51, and, if so, describe it?—The Sylvester

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stove was used, the principle of which is a large fire-place in the main hold of the ship with air pipes led through each cabin, and along the side of the ship to the extreme end forward; but there was difficulty in regulating the amount of heat. My cabin, situated opposite the main hatchway, receiving the first of the heat, was too warm, and collected a very great amount of moisture in consequence, while at the extreme ends of the ship the decks and cabins were cold; that defect no doubt could be rectified, but there would be a loss of ventilating tubes for ventilating the habitable deck if the Sylvester stove is again used.

222. Therefore, taking everything into consideration, you consider the mode adopted on board the "Alert" as the more effective of the two?—Yes, except as regards the expenditure of coal; and with regard to that, although I believe it to be about equal for each system adopted, I cannot speak with certainty.

223. (*Admiral Collinson.*) Was the moisture on the lower part of the upper deck ever frozen with you?—Owing to the equable temperature which we were able to obtain, and to the ship's side being lined with fearnought previous to our leaving England, there was very little ice formed inside of the ship. In fact I do not remember any, except on the one or two bolts which had been accidentally neglected to be covered; but certainly ice was not formed to any extent. The temperature of the lower deck varied between 40 degrees and 50 degrees the whole winter.

224. Where was the thermometer placed?—I had a great number about the deck; they were hung up in five different places on the mess deck at different heights from the deck, and other thermometers in other parts of the ship.

225. Are you of opinion that, as far as ventilation is concerned, the lower deck of the "Alert" was in better condition during the winter than that of the "Resolute"?—I can only speak by memory. I know that on board the "Resolute" the beams were always damp, like the "Alert's," and that the deck itself was frequently wet, and I believe more frequently so than the "Alert's."

226. (*Dr. Fraser.*) I should like to ask what was the general cubic space which you allowed per head, or which you were able to give per head?—I cannot state fully; but the crew consisted of fewer men than the crew of the ship when she was a man-of-war, occupying the same space, and each man's hammock had a double berth. Certainly they had a very much larger space than the crew of the "Resolute."

227. So far as you know or observed, the condition of the atmosphere in the ship was not bad?—Dr. Moss can give the exact information to the Committee on the subject; observations were frequently made of the state of the air, and always reported to me by the medical officers as being satisfactory.

228. (*Dr. Donnet.*) Was the ventilation of the lower deck dependent upon the several stoves distributed about the ship?—Upon that and the two hatchways to which doors were fitted, but through which there was an interchange of air every time a man or officer went up or down the ladder.

229. Were these hatchways the only outlets for air, and the only means of admitting fresh air?—I have already stated that the plan adopted of heating the ship by five or six stoves enabled a system of ventilation to be arranged with their funnelling. The whole ventilation of the ship depended upon the two hatchways and the stove funnelling, and two tubes which acted as down-takes, one in the ward-room and one in my cabin. I should say apparent down-takes, for the cold air in descending at the outer circumference of the tube is rendered visible as it arrives in the warmer atmosphere. The heated air in the same way, ascending through the centre of the tube, makes itself visible on arriving at the outer cold air. I think it was only the stove funnellings that were absolutely up-takes, with the exception of the hatchways when the door was open.

230. Did you consider this system of ventilation as perfect as it could be made on board an arctic

ship, and were you able by it to renew the atmosphere of the decks frequently?—It is as perfect as necessary. With only a few degrees difference of temperature between the habitable part and the outer air very slight currents are formed; but with the difference of temperature between the habitable deck on board a ship in the arctic regions and the outer air, which is always from 80 to 100 degrees, the very smallest opening enables a very strong current of communication to be established, and sufficient air is interchanged then through a small opening to ventilate the habitable deck.

231. Did this system of ventilation tend to diminish the moisture of the atmosphere?—Immediately an opening was made which enabled extra ventilation, so immediately the damp collected on the beams in consequence of the large down rush of cold air. I may state that the increased dampness of the lower deck beams with increased cold, is produced in the same way by the cold being communicated down through the deck by conduction.

232. What amount of snow did you place on your upper deck to preserve the warmth of the ship?—The enbanking the ship with snow was continued up higher on the outside than had formerly been the case, and the upper deck had an increased layer of snow. The layer originally was about 1 ft., but I allowed this to accumulate throughout the winter, and at the end it had certainly collected to a thickness of over 2 ft. Also a very complete covering was arranged for over every hatchway, and by this means no possible outer air could get down into the holds by any communication, and consequently the warmth of the air down there was not lowered below a temperature of + 28, which would not freeze the provisions. The holds were at the same time frequently opened in communication with the lower deck.

233. What means did you take to keep the bilges sweet, and what disinfectants did you use?—The ship was thoroughly dry; there was no water whatever in the hold; had there been any, it would have been frozen.

234. Did you ever remark any foul smells arising from the holds?—No, none at all, excepting in the summer, after the thaw had commenced, and a total restowage of provisions was going on.

235. Did you find it necessary to alter the berthing of your men, or was each man berthed, and allowed to retain his berthing during the commission of the ship?—There were probably half-a-dozen men whose sleeping berths had to be altered in consequence of being too near the cold air coming down the hatchway. The ship's steward also had to be taken out of his cabin in consequence of its dampness, and made to sleep in a cot, he being unable to take the same precautions that an officer could in his cabin.

236. (*The Chairman.*) Proceeding to the 8th paragraph: "Under the generally depressing influence of arctic service the importance of promoting hilarity and cheerfulness as sanitary agents is paramount." Was that attended to?—Nothing could have been more cheerful than the lower deck of the "Alert" throughout the winter; owing to the increased space, we were enabled to devote greater space than is usual for the recreation and comfort of the crew.

237. (*Dr. Donnet.*) Was it remarked that of those who held back from these amusements some afterwards suffered from scurvy?—No one held back. On each Thursday, when Penny Readings were held, there would only be two or three men left sitting in their messes; and the daily school on the lower deck was very fully attended from first to last.

238. (*The Chairman.*) Proceeding to the 9th paragraph: "Men before they are selected for sledge or travelling parties should be examined by the medical officers, as to the existence of any defect that might possibly render them inefficient, and they should be again examined on their return to the ship." Was that strictly carried out?—Yes, and a report made to me by Dr. Colan.

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239. (*Dr. Fraser.*) The reports that were made to you were never of such a nature as to prevent your sending these men on excursions?—I can give the Committee the report which will show that all the men were pronounced in good health (*producing it*). If one or two men are not mentioned in that report, they were examined by Dr. Colan on the 1st day of April, only two days previous to the start of the sledges. (Appendix No. 7.)

240. (*The Chairman.*) Proceeding to the 10th paragraph: "A small supply of such surgical appliances and medicines as might be considered by the senior medical officer of the ship suitable for meeting ordinary slight casualties and illness, with clear and well-defined instructions for use, should be placed in charge of the officer commanding the party; and the petty officers in charge of the sledge should be practically instructed in the use of such appliances before leaving the ship." Was that carried out?—Yes, with the exception of the petty officers being instructed more than any one else; but the instructions drawn up by the medical officer of the ship were very clear and precise.

241 And these instructions were generally made known to all the men who travelled?—Yes.

242. Proceeding to the 12th paragraph: "Snow-blindness should be carefully guarded against in travelling and excursion parties during the spring and summer months; after the sun reappears, veils or neutral-tinted glasses or goggles should be worn to obviate the occurrence of this painful and troublesome affection, a severe attack of which at once renders men for a time inefficient, as it comes on as a rule suddenly if the eyes are much exposed to the combined influence of snow and sunshine." What measures did you take in regard to this recommendation?—My former experience informed me how very important it was to guard against snow-blindness, and such accidental affections as those to which sledge travellers are liable. On the last Thursday previous to the starting of the sledge parties, I gave the men a lecture on these matters; and previously, with regard to snow-blindness, I had taken all the precautions possible in issuing goggles, and in having each man's duck-jumper painted with some device on the back, on which the eyes of the man behind him might rest. This was fully carried out, and was pleasing to the men, enabling each to have a kind of crest or coat-of-arms of their own; the snow-blindness which attacked our sledge parties somewhat was very much less severe than that experienced by previous expeditions.

243. Proceeding to the 13th paragraph: "Men should at once make known to the officer in command the occurrence of this or any other casualty, however slight, the moment they are aware of it. Total exclusion from light, by bandaging the eyes, and the application of ice or cold lotions will be found efficacious in the treatment of snow-blindness." Were these measures strictly enjoined on the officers and men proceeding on the sledge parties?—Yes; and further, Captain Stephenson and myself took the precaution of sending away the junior surgeon from each ship with the sledge parties in order that they might attend to any casualty that might occur during the first few inexperienced days.

244. Proceeding to the 14th paragraph: "As accidents may frequently occur from the careless use of fire-arms, a field tourniquet should always be supplied to travelling or shooting parties, and some intelligent person instructed in its use." Was this suggestion carried out?—To the best of my belief the sledge parties carried tourniquets, but short shooting parties did not.

245. Proceeding to the 15th paragraph: "Frost-bites will be of frequent occurrence, chiefly on the exposed parts of the face, hands, and feet. Nothing can be better to restore the circulation in the frozen part than gentle friction with the hand. If the feet or hands

are extensively frost-bitten, great care should be taken not to use stimulating applications in the first instance, otherwise acute inflammation, followed perhaps by mortification of the part, is likely to ensue. Should this unfortunately occur, then the disease must be treated on general principles." What measures did you take in regard to this suggestion?—The sledge parties were very severely attacked by frost-bites in the autumn of 1875, in consequence of their inexperience; and I consider that no man without experience can fully realize the danger of a frost-bite, in consequence of the total absence of feeling when the part is affected. But after the experience gained in the autumn, no serious case of frost-bite occurred, except in the case of Petersen, which was a peculiar one. It attacked him owing probably to his being in a bad state of health. I mean that it was not a casual frost-bite. I fully impressed each officer previous to starting on his journey with this danger, but it occurred nevertheless.

246. And when you impressed them with the danger arising from frost-bites, did you point out to them, or take any measures for acquainting them with the best mode of dealing with them?—They were fully instructed in these matters. The frost-bites were occasioned by the men getting wet in the feet some three or four hours previous to the regular inspection of their feet after encamping at night.

247. (*Dr. Donnet.*) Is it not the case that casual frost-bites may occur to the face and other exposed parts? Did you take precautions that men allowed to go on the floe should never go out alone, so that, should one man be frost-bitten, a second might, by his observing this casualty, assist in restoring the circulation?—It is always necessary in the arctic regions to walk about with a companion. In consequence of the fact that when any part becomes frost-bitten there is no feeling in that part, and the presence of a frost-bite is not known unless seen by the companion, who is therefore enabled to give information concerning it, and to help in the restoration of the circulation.

248. (*The Chairman.*) Proceeding to the 16th paragraph: "Each ship will be supplied with a few copies of the medical and surgical handbook issued from this department for the use of small ships not carrying medical officers, which, although of too comprehensive a character for arctic service, yet, as directions are laid down for casualties and slight diseases, I think it will be found of much use to officers on detached service, and where no medical assistance is available." What use did you make of these books?—I do not remember those books having been supplied. I myself have certainly never previously seen the handbook alluded to; but these books were supplied.

249. Proceeding to the 17th paragraph: "A copy of a book published by me on 'Naval Hygiene and Scurvy,' embodying my experience of this disease, will also be supplied to each ship, and will, I hope, furnish a suitable guide in its treatment, should it unfortunately occur." Was that transferred to the medical officer of the ship?—Yes.

250. Proceeding to the 18th paragraph: "As a convenient mode of applying ice in cases of snow-blindness, I have directed a supply of goggles, specially made for the purpose, to be furnished to each ship for the use of the travelling parties; also several sets of splints, light, portable, and well adapted to meet the occurrence of casualties when absent from the ship. Both these appliances were invented by the late Surgeon-Major Wyatt, C.B., and will, I hope, prove as useful as I anticipate." In regard to these, will the medical officer of the ship be able to afford us information?—So far as the supply to the sledge parties is concerned, and their being used on board ship, but not with regard to their use while sledging; but I am certain that the goggles, if supplied, were useless for the purpose for which they were furnished.

The witness withdrew.

Adjourned to to-morrow at 11 o'clock.

FRIDAY, 12TH JANUARY, 1877.

PRESENT:

ADMIRAL SIR JAMES HOPE, G.C.B., in the Chair.

ADMIRAL SIR R. COLLINSON, K.C.B.

VICE-ADMIRAL E. A. INGLESFIELD, C.B., F.R.S.

JAMES J. L. DONNET, ESQ., M.D., Inspector-General of Hospitals and Fleets, R.N.

THOMAS R. FRASER, ESQ., M.D., F.R.S.E.

H. J. VANSITTART NEALE, ESQ., Secretary.

CAPTAIN SIR GEORGE STRONG NARES, R.N., K.C.B., F.R.S., *further examined.*Capt. Sir G.
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R.N., K.C.B.,
F.R.S.

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251. (*The Chairman.*) Will you furnish the Committee with a return in the form which has been supplied to you, showing the details of your previous arctic travelling?—Yes.

252. Will you produce the following returns: First—The dietary of the men on board the “Alert” during their absence from England, showing any change and the ground for it?—Yes; I request that Lieutenant Egerton, who did the paymaster’s duty, may be placed at my disposal for that purpose.

The witness withdrew.

CAPTAIN HENRY FREDERICK STEPHENSON, R.N., C.B.

Capt. H. F.
Stephenson,
R.N., C.B.

12 Jan., 1877.

254. (*The Chairman.*) On what day was the “Discovery” commissioned by you as captain?—On the 15th of April, 1875.

255. On what day were you placed under the orders of Sir George Nares; and produce the order?—I have not got the order with me to-day, but it was contained in the sailing directions, and I think it was dated the 26th of May, 1875.

256. Was the equipment of the “Discovery,” so far as regards the special service on which she was to be employed, placed under the supervision of Sir George Nares?—Yes.

257. If you received any order to that effect produce it?—I received no order.

258. It is understood that the Admiralty appointed a committee, consisting of Admirals Richards, Sir Leopold M’Clintock, and Sherard Osborn, to report to their Lordships, first, on the special equipment of the ships; and, secondly, on the instructions for the conduct of the expedition. Were you placed in official communication with that committee?—No.

259. Were you in private communication with the committee, or with the officers of which it was composed individually, and to what extent did you avail yourself of their advice or assistance?—No, I was not.

260. Produce all the instructions issued by the Admiralty for your guidance relative to the expedition?—I will. They were the sailing orders, I think, of the 26th of May. (Appendix No. 9.)

261. Were those accompanied by a letter from the Secretary to the Admiralty of May the 8th, 1875, forwarding, for your information and that of Sir George Nares and the medical officers of the expedition, a memorandum from the Medical Director-General of the Navy, containing suggestions and recommendations as to the health of the arctic expedition of 1875–76?—Yes.

262. In the copy of the said memorandum, having numbered the paragraphs, I request that you will state, as I read them *seriatim*, whether the suggestions and recommendations therein contained were carried out, or, if otherwise, to what extent, and the ground on which they were not fully complied with. Taking therefore the first: (1) “In connection with arctic service, there is nothing more important than the selection of officers and men in regard to their physical fitness (and I would also say moral fitness, where it can be ascertained, as there is no service in which both are more severely taxed); but the remarks to which I have already drawn the attention of the Arctic Committee on this important question appear to be now

253. Will you produce, secondly—A return of the temperature on board and alongside the “Alert” during the period of the winter quarters. (Appendix 8.) Thirdly—A list of the captains of messes, showing age and ratings, and whether captains of sledges. Fourthly—Copies of the certificates of Stone and Chalkley. Fifthly—A return of the savings on board the “Alert” during the period of her absence from England, exclusive of those of the officers?—Yes.

unnecessary, as the officers and crew have all been entered.” Had this recommendation been carried out?—I believe it had. I entered myself nearly all the men for both ships.

263. (*Admiral Inglesfield.*) Why did you enter all the men for both ships, for the “Alert” as well as your own?—I cannot answer that question.

264. How was it that the captain of the “Alert” did not enter his own men?—Because he was otherwise employed.

265. Then you were on the spot, and therefore entered the men for both ships, Captain Nares being absent?—Yes.

266. (*Dr. Fraser.*) As the result of this selection you were quite satisfied with the crew which you had immediately under your command?—Perfectly.

267. You were quite satisfied both in respect to their physical and to their moral qualities?—Yes.

268. You had means, no doubt, of ascertaining the previous history of each of the men selected?—Yes; from their certificates.

269. (*Dr. Donnet.*) When the men were entered by you, had they been already examined by the medical officer of the expedition?—After their certificates had been gone into by me, they were passed on to the medical officer for the medical inspection.

270. Were all the men entered by you accepted by the medical officer?—Every one.

271. (*The Chairman.*) (2) “Assuming, therefore, that the crews of the ships have been selected as nearly as possible in accordance with my recommendation as to their physical fitness, being of good constitution and sound in all respects, the great object now in view is to maintain them in the same state of health and vigour as when they were entered. This can only be done on polar service by the use of a liberal dietary, both in animal food and vegetables. I consider the former should consist of 2 lbs. of meat daily, viz., 1 lb. at dinner, and $\frac{1}{2}$ lb each at breakfast and supper, with a proportionate quantity of vegetables and antiscorbutics. I am not aware at present how far this scheme of diet will be carried out; but, if acted on, I would anticipate little or no impairment of the physical powers; but, on the contrary, with a scale of diet smaller than this, I consider that debility of a scorbutic nature must ensue, and that at an early period, if the men are much exposed to hard work and intense cold. (3) Fresh preserved meat should alternate with salt meat each day, with a due quantity of vegetables, and the latter should be such as are of the most succulent character. I know no vegetable to equal cabbage for such service; this, and Edwards’s

preserved potatoe, should, in my opinion, form the bulk of the vegetable food. (4) Pickles of a succulent character should be added to the diet on each day that salt meat is issued, in addition to the ordinary quantity of vegetables, and, except as an adjunct, soup should not enter largely into any diet list for working men as a substitute for meat. (5) Assuming that provision may have been made for giving 2 lbs. of meat to each man daily in the proportion before stated, viz., 1 lb. at dinner, and $\frac{1}{2}$ lb. each at breakfast and supper, I consider that the breakfast and supper meat should be duly alternated as the dinner meat is from day to day." In reference to this suggestion, will you produce a return of the dietary on board the ship during her absence from England, showing the changes, if any, and stating why they were adopted?—Yes. (Appendix No. 10.)

272. (*Admiral Sir R. Collinson.*) Was this scale of diet adopted by you in consequence of an order from Sir George Nares?—Yes.

273. (*Admiral Inglefield.*) Did you in any way alter the scale of diet upon the outbreak of scurvy?—Previously to the outbreak.

274. You mean when premonitory symptoms showed themselves?—The diet list was frequently altered, independently of premonitory symptoms.

275. You took upon yourself to make other alterations independent of this scale of diet which is now put in, and which provides for a certain change?—I did.

276. Was that by order of Sir George Nares?—Yes; when fresh meat was procured.

277. Then I understand that the cause of the alteration of the diet was to admit of the introduction of fresh meat when it could be obtained?—Yes; that will appear in the return which I have already handed in, showing the different occasions when it was altered.

278. (*Dr. Fraser.*) The modifications which you refer to were, not, in your opinion, very important modifications from the scale which we have here?—There are several modifications in that return; there was a slight increase to the meat on several occasions.

279. And an increase in the allowance of fresh meat wherever possible?—Yes.

280. As a result of your observations with this scale of dietary and with the modifications to which you have alluded did you find that it was such a scale as was capable of maintaining the health of your crews during the time while it was in use?—Yes.

281. I observe in the dietary that fruit is one of the articles noted, can you tell the Committee what fruits were used?—The fruits supplied were bottled fruits and pippins.

282. I also notice that vinegar is entered in the scale with the direction, "as may be found necessary." As a matter of fact, was vinegar largely used, or to what extent?—I am not aware of the extent to which it was used, but it was issued according to the custom of the service.

283. Did the dietary used by the officers in your ship differ in any respects from that represented by this scale?—Yes, slightly.

284. Could you inform the Committee generally of the difference between the two?—The officers always had butter, milk, cheese, jams, sauce, soup, rice, hams, tongues, and a few vegetables, besides an allowance of wine daily.

285. What wine?—We had 16 glasses of wine per week, sherry, port or madeira, and a bottle of brandy or whisky every ten days.

286. I observe also that in the scale of dietary one ounce of lime juice daily is entered, was that quantity regularly given?—Yes, always whilst the men were on board.

287. Was the quantity increased at any time?—Yes.

288. When and to what extent?—It is contained in my report.

289. (*Dr. Donnet.*) You have said that you considered the diet supplied to the expedition sufficient for all the requirements of men employed in arctic

service, have you thought upon this question, and can you suggest any improvements or any change in this respect?—I think the supply of provisions was most liberal. I have not thought of what alteration I should make for further arctic service.

290. You are of opinion that this dietary was sufficient?—Yes.

291. Your alteration made in the dietary supplied was due, you say, to the quantity of fresh meat secured; can you furnish the Committee with the amount of fresh meat which you were able to obtain?—Yes, we had at the beginning of the winter about 3,053 lbs. of fresh meat hanging up outside the ship; 800 lbs. a month was about the usual consumption.

292. The allowance of rum supplied to the men was according to the dietary, half-a-gill per man, was this allowance ever exceeded?—Yes.

293. At what time and for what period was that extra allowance supplied?—From the 16th of October, 1875, to the 1st of March, 1876, a double allowance was issued, with the exception of Christmas week.

294. Had you any reason for issuing this extra supply of spirits; was there anything in the health of the men that indicated a necessity for so doing?—Not that I know of.

295. Did you believe that the men would be benefited by this extra allowance?—I am not prepared to answer that question.

296. Do you not consider that half-a-gill of rum is a sufficient allowance for a man per day?—I think it may be considered sufficient for most men; I do not drink rum myself.

297. In the experience which you had of sledge travelling did you find that spirits added to the physical endurance of the men?—I never saw rum served out whilst they were at work; it was only taken at night after the work was over, before going to sleep. I do not know whether it would add to their physical powers.

298. Do you think it enabled them to support the cold better?—Yes; I am of opinion that it was almost considered a luxury during the very cold weather whilst sledging in the early spring of the year, and that is the only time I took it myself.

299. Do you therefore speak from your personal experience?—Yes, and from what I have heard from my companions.

300. Would you recommend a supply of spirits to be furnished to all future arctic travelling?—Yes.

301. (*The Chairman.*) Referring to the report on the victualling of the "Discovery" given in with your return of dietary, I will now proceed to read it, paragraph by paragraph, and such questions will be put as it suggests, beginning with No. 4, in which you say, "On the 10th of June the victualling according to the scale mentioned in paragraph one was begun"?—Yes.

302. (*Admiral Sir R. Collinson.*) Have you reason to suppose that the men could have consumed a greater portion of meat than is included in that No. 1 ration?—No.

303. In your opinion that ration then was ample?—Quite.

304. Had you any reason to suppose that on that ration any provisions were saved by the ship's company?—None on board the "Discovery," with the exception of biscuit.

305. (*The Chairman.*) (Par. 5.) "On the 23rd of July one ration of looms was made to the officers and ship's company." Were those looms obtained in any quantity or were they brought from Melville Bay?—They were killed at Sanderson's Hope; they were shot one night and issued the next morning.

306. (*Admiral Sir R. Collinson.*) What proportion of birds were issued?—I think a bird a man throughout the ship.

307. (*Dr. Donnet.*) Besides the looms did you obtain any eggs?—No.

(*The Chairman.*) (Par. 6.) "On the 20th of August one day's fresh mutton was issued."

308. (*Dr. Donnet.*) Did the officers take any sheep

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to sea with them?—There were a few sheep supplied to the ship.

309. Was mutton supplied during the winter season?—Yes.

310. How did you preserve it?—It was frozen.

(*The Chairman.*) (Par. 7.) “Between the 28th August and the 5th September, 1875, musk-ox beef and salt meat was issued alternately, the ration of each being one pound, but without preserved meat.”

(Par. 8.) “Between the 6th September and 4th October the issues of musk-ox beef were irregular, depending mostly on the amount brought on board.”

(Par. 9.) “Between the 16th October, 1875, and the 29th February, 1876, the period during which the sun was absent, a double allowance of rum was issued, making the ration one gill.”

311. (*Dr. Fraser.*) Why was this allowance of rum doubled?—From orders received from the Admiralty to Sir George Nares.

(*The Chairman.*) (Par. 10.) “Between the 4th October and 1st December the issue of meat was as follows: Sunday, 1 lb. of salt pork; Monday, $\frac{3}{4}$ lb. of preserved meat; Tuesday, $1\frac{1}{2}$ lb. of musk-ox beef; Wednesday, 1 lb. of salt beef; Thursday, $\frac{3}{4}$ lb. of preserved meat; Friday, $1\frac{1}{2}$ lb. musk-ox beef; and Saturday, 1 lb. of salt pork.”

312. (*Admiral Sir R. Collinson.*) When this increase of meat ration was issued, were there any savings made by the ship's company in those articles?—No.

313. (*Dr. Donnet.*) On Tuesday and Friday the amount of musk-ox beef, you say, was $1\frac{1}{2}$ lb. to each man; did the men consume this quantity?—Answering this question in a general way, the musk-ox beef was very strong flavoured, and I believe in some cases was not eaten at all by the men.

314. Were there many cases in which the men refused to take this musk ox?—I do not know the numbers, but it was not popular on the lower deck.

315. Do you know whether the men who refused it suffered subsequently from scurvy?—I do not know.

316. (*Dr. Fraser.*) When you increased this quantity of fresh meat, or when you increased the quantity of fresh or salt meat at any time, was there a corresponding or any diminution in the quantity of vegetables or other antiscorbutics issued or consumed?—No; because I could never lose sight of the fact that the stores on board were intended for a commission of three years.

317. You mean by that, that had you diminished the quantity of vegetables or antiscorbutics issued, you did not dread that the store would fail, but that the health of the crew would suffer in this long commission?—I did not consider it necessary to make any change in the scale of provisions that we left England with. I made no change in anything but the meat.

(*The Chairman.*) (Par. 11.) “On the 1st December the scale of victualling at paragraph 1 was resumed.” (Par. 12.) “During Christmas week fresh mutton was issued three times; on Christmas day at $1\frac{1}{2}$ lb. a man, and on the other days at 1 lb. On Christmas day the following extra issues were made: Coffee, 1 oz. a man; flour, 1 lb. a man; suet, 2 oz. a man; raisins, 3 oz. a man; bacon, 6 oz. a man; pippins, 4 oz. a man; sugar, 8 oz. a man; ale, 1 pint, in lieu of a half-a-gill of rum, a man.” (Par. 13.) “On the 4th January, 1876, recommenced the issue of musk-ox beef, as in paragraph 10, but the ration was reduced to 1 lb. instead of being $1\frac{1}{2}$ lb.” (Par. 14.) “On the 4th March, 1876, the musk-ox ration was increased to $1\frac{1}{2}$ lb.” (Par. 15.) “On the 28th March, 1876, the issue of musk-ox beef ceased, the supply failing, and the original scale of victualling was again reverted to. On the 30th the preserved meat ration was increased to 1 lb.” (Par. 16.) “On the 19th April, 1876, the preserved meat ration was reduced to $\frac{3}{4}$ lb.”

318. (*Admiral Sir R. Collinson.*) Had you any cause for this decrease?—Yes. On the 16th I left the ship for the “Alert,” and nearly all hands were away sledging with the exception of about 12 people,

shipkeepers. I then directed the original scale of victualling to be adhered to.

319. (*The Chairman.*) (Par. 17.) “On the 5th May, 1876, the issue of the meat ration was as follows, other articles remaining unaltered: Sunday, 1 lb. of preserved meat; Monday, 1 lb. of preserved meat; Tuesday, 1 lb. of salt pork; Wednesday, 1 lb. of preserved meat; Thursday, 1 lb. of preserved meat; Friday, 1 lb. of salt beef; and Saturday, 1 lb. of preserved meat.” What was the occasion for the change?—On my return to the ship, on the 4th of May, the western sledge parties had returned, all in excellent health; having economised so much preserved meat during the winter, and the men themselves taking much exercise, I altered the scale to two days salt meat during the week, and on the other five, 1 lb. of preserved meat.

320. The ground for doing so being that the stock of preserved meat on board would stand it?—Yes.

321. (Par. 18.) “On the 10th May, 1876, the meat ration was as follows:—Sunday, $1\frac{1}{4}$ lb. of preserved meat; Monday, $1\frac{1}{4}$ lb. of preserved meat; Tuesday, $1\frac{1}{4}$ lb. of salt pork; Wednesday, $1\frac{1}{4}$ lb. of preserved meat; Thursday, $1\frac{1}{4}$ lb. of preserved meat; Friday, $1\frac{1}{4}$ lb. of salt beef; and, Saturday, $1\frac{1}{4}$ lb. of preserved meat.” What was the occasion of this increase of a $\frac{1}{4}$ lb.?—On the 10th of May the meat was increased by a $\frac{1}{4}$ lb. in consequence of the perpetual daylight, and the increasing warmth of the sun, which caused the men to be a good deal absent from the ship, shooting over the adjoining hills, and returning late on board. This little increase gave them sufficient for supper, before turning in.

322. (Par. 19.) “From the 12th June, 1876, a ration of flour was issued on soup days, in addition to that on salt-beef days.” What was the reason for his alteration?—This increased ration of flour was issued at the men's own request.

323. (Par. 20.) “Between the 17th June and 31st August, there were 28 days on which musk-ox beef was issued, 32 days on which preserved meat was issued, 16 days on which salt meat was issued. During this period many parties were absent from the ship on detached duty, and the victualling was irregular, so far as the issue of meat was concerned.” (Par. 21.) “On the 7th August, 1876, an extra ration of 4 oz. of bacon a man a day was commenced, and continued till arrival in England.” What occasioned this alteration?—We had a large quantity of bacon on board, and this ration was also issued at the men's own request.

324. (Par. 22.) “On and after the 9th of August, 1876, the allowance of lime juice was doubled, making the ration 2 oz.” What was the occasion of this alteration?—The double allowance of lime juice was issued, at Dr. Ninnis's suggestion, to men and officers.

325. (*Dr. Fraser.*) Have you any idea on what grounds Dr. Ninnis made this recommendation?—Yes. Nearly all the sledge parties had returned, and we had several cases of scurvy then on board.

326. The one-ounce daily ration of lime juice had never previously to this date been increased, in that case?—Only to those men that Dr. Ninnis suggested.

327. But never as a general ration?—No, not as a general ration.

328. (*Dr. Donnet.*) Do you know whether a double allowance of lime juice was given as a curative?—I do not know.

329. Was it given to all the men returning from the party, or merely to those who were suffering from debility or other symptoms?—It was given at his suggestion to everybody in the ship from this date.

330. (*The Chairman.*) (Par. 23.) “On and after the 18th August, 1876, a double allowance of fruit and sugar was issued, making the ration: fruit, 4 oz.; sugar, $1\frac{1}{2}$ oz.” What was the occasion of this alteration?—The day we left our winter quarters to come south, a double allowance of fruit and sugar was issued, by Dr. Ninnis's suggestion.

331. (Par. 24.) “On the 1st September, 1876, a

ration of seal meat (2 lbs.) was issued to the officers and ship's company." (Par. 25.) "From the 1st September till our arrival in England, two days' preserved meat to one of salt was issued, as in paragraph 18." What was the occasion of that alteration?—That I also think was at the suggestion of Dr. Ninnis. At the time of the last few alterations, we were close to England, and it was a matter of little or no consequence, we considered, how those rations were served out, so long as they were to the liking of the men and officers on board.

332. (Par. 26.) "On the 20th September, 1876, the allowance of lime juice and sugar was increased to 3 oz. per man." What was the occasion of that increase?—That was merely that they might have as much as they liked. There was no limit just then.

333. (*Admiral Sir R. Collinson.*) Had you then many cases of scurvy on board?—None.

334. Was the ration issued more than once a day?—From the 9th August it was issued twice a day.

335. (*Dr. Donnet.*) Do you know, from your own personal observation, whether any man took the allowance of three ounces per day?—I am not aware.

336. (*The Chairman.*) (Par. 27.) "On and after the 29th September, preserved fruits and sugar was issued every day at the rate of 2 oz. a man." What was the occasion of that change?—I think I may embody the whole of these last alterations in stating that the ship was in the Atlantic, and, when once the ship was clear of ice, so long as there was no waste, there was no restriction in the issue of provisions.

337. (Par. 28.) "The sledging rations during the spring were as follows: Preserved potatoes, 2 oz. per man for one day; biscuit, 14 oz.; pemmican, 1 lb.; bacon, 4 oz.; chocolate, 1 oz.; sugar (for tea and cocoa), 2 oz.; tea, $\frac{1}{2}$ oz.; pepper, $\frac{1}{16}$ oz.; salt, $\frac{1}{8}$ oz.; onion powder, or curry paste, $\frac{1}{8}$ oz.; rum, $\frac{1}{2}$ gill; tobacco, $\frac{1}{2}$ oz.; spirits of wine, $\frac{1}{2}$ oz.; and stearine, 3 oz." Was that ration found on experience to be sufficient?—Yes.

338. (*Admiral Sir R. Collinson.*) When you first went away on your sledging expedition, did the men consume the whole pound of pemmican each?—No.

339. Will you inform the Committee when they began to consume the pound?—I was never away long enough sledging at one time to find out when it was consumed.

340. So far as your experience goes, one pound of pemmican in conjunction with a quarter of a pound of bacon is as much as a man can consume when absent on sledging parties?—Yes, ample; but of course there are circumstances which make a difference in that respect, and there are men, too, who will eat more at some times than at others.

341. Would you, from your experience, suggest in future that the bacon allowance should be increased?—No.

342. (*Dr. Fraser.*) You say that this ration was a sufficient one; in your opinion, or as the result of your experience, was it a satisfactory ration for sledge parties, and one which you would feel inclined to recommend on future occasions of a like nature?—I think it was sufficient and satisfactory, but I have not studied the question sufficiently to know whether there is any substitute that would be as good.

343. Was the health of the men satisfactory whilst they were consuming this ration?—No.

344. Was the health of the men satisfactory whilst they were consuming the ship's ration?—Not on all occasions.

345. What occasions do you refer to on which the health of the men was not satisfactory whilst using the ship's ration?—We had one case of scurvy on board during the winter, but otherwise the men were in fairly good health generally.

346. Is the case to which you allude that noted in your Reports of Proceedings when Detached, at page 6, paragraph 74?—Yes.

347. This was the first case of scurvy occurring in the crew under your command?—Yes.

348. How was this man employed on board the ship

previously to his attack?—He was generally employed by the ship's steward in the general issue and supply of provisions, and in his duty as cooper.

349. He became ill, did he not, at the commencement of January, 1876?—Yes.

350. Was his personal character perfectly satisfactory?—Yes, on board.

351. Have you any reason for restricting your answer to the time during which he was on board?—Yes.

352. What reason?—He was a man above the prescribed age, and there was a great difficulty when entering the men to obtain a cooper.

353. Then, do I understand that your only objection to employing this man was his age?—Yes, so far as I know.

354. Had you heard anything unsatisfactory respecting his personal character at any time?—Never during the time he was under my command. He was reported to me as a troublesome patient by the surgeon, but that was owing to his disease, and in no other respect was he ever complained of to his commanding officer as to his conduct in the ship.

355. Had his health been good previously to this attack of scurvy?—I believe it had.

356. Referring you again to paragraph 74 in the report, which I have named, I observe you say that: "With the exception of Shepherd, who is constitutionally predisposed to scurvy, there could not be a healthier body of men." Will you explain to the Committee what you mean by "who is constitutionally predisposed to scurvy"? Dr. Ninnis reported to me that this man was not of a good constitution, and he believed he had been a hard drinker, but that was some time ago.

357. Returning to the two diet tables, I understand that whilst the ship's diet was being consumed by the men only one case of scurvy originated, whereas whilst the sledge-party diet was being consumed a considerable number of cases of scurvy occurred; is that so?—Yes.

358. I also observe that in the sledge-party diet the proportions of so-called antiscorbutics are smaller than in the on-board ship dietary: can you explain why lime juice was not placed in the sledge-party dietary?—It was not considered necessary at that time.

359. In your opinion, could the quantity of sugar in this sledge-party diet have been diminished at all?—Possibly it might.

360. As a matter of fact, was all the rum which you carried consumed?—Yes: but not all drunk.

361. How was it consumed?—By burning. If there was any to spare it was used for the purpose of thawing the ice and snow and procuring water.

362. (*The Chairman.*) Proceeding to the third paragraph of the "Suggestions": "I attach the greatest possible importance to the daily administration of lemon juice to commence on the day after the fresh vegetables cease on leaving England; but this must be carried out on the most rigid principles, on which it was without one day's interruption carried on on board the 'Investigator' on my representation of its absolute necessity, viz., by having the aggregate allowance of acid, one ounce per man, with a proportionate quantity of sugar and water, mixed in a tub and drunk on deck in the presence of the officer of the watch. I cannot overrate the importance I attach to the adoption of a similar course in the present expedition, and would urge its being carried out in the strictest manner. By doing so, there will be positive evidence that every man in the ship is fortified with an antiscorbutic agent of undoubted efficacy; whereas in the course usually adopted, of sending the lemon juice to the several messes for consumption, there is no evidence whatever of any man taking it, and so valuable an agent should not be left to the whim or caprice of individuals, but rigidly enforced as an element of their safety." Was this suggestion of the Medical Director-General of the Navy strictly carried out?—Yes.

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363. Was it strictly carried out when you issued the double allowance of lime juice, with reference to the additional quantity?—It was always issued at the tub.

364. (*Dr. Donnet.*) Was there any exception to this daily issue, whether amongst the petty officers or men; did all men take it at the tub?—Everybody but the officers. It was referred to the petty officers at what time they would like to have the lime juice issued, as it was to be drunk on the quarterdeck, in the presence of the officer of the watch; and they decided at half-past ten in the forenoon for the forenoon watch, and half-past two in the afternoon for the afternoon watch; and during the winter it was mixed on the lower deck and served out at half-past eleven to all hands.

365. Was this always done under the superintendence of an officer?—Always up to the winter, when the orders were for the officer of the day to attend its issue; he was sometimes called away for other duties, astronomical observations, or whatever his own particular branch of science might be, which took his attention away from it for the time. I have every reason to believe that no single person ever declined it.

366. (*The Chairman.*) Proceeding to the fourth paragraph: "When it may become necessary to recruit men after great or unusual fatigue, either in working a ship through the ice after midnight, or on long marches when travelling, I consider cocoa or tea infinitely preferable to spirits, hitherto generally given, and I think the use of the latter should be abandoned on such occasions as far as practicable." Was this suggestion carried out, and if so, with what result?—Whenever it was necessary to give an extra issue at night for overwork, cocoa or coffee was always given. On no occasion was rum issued.

367. Proceeding to No. 5: "When in winter quarters daily exercise should be rigidly enforced on all whose duties do not require them to remain on board, and the hours between breakfast and dinner, and between dinner and supper, should be entirely devoted to it or to work, as may be necessary, outside the ship, so as to insure about six hours during the day. The indoor workers, commonly termed 'idlers,' will, if permitted, evade exercise; but it should be enforced on them at periods when they are not required on board." Will you furnish us with a copy of your daily routine during the winter quarters?—Yes. (Appendix No. 11.) For five hours a-day throughout the winter the men were employed outside the ship.

368. (*Admiral Sir R. Collinson.*) With respect to the cooper, James Shepherd, did he take that exercise outside the ship which the remainder of the ship's company would do?—I am under the impression that he did; the stores that he was continually bringing off from the store tent to the ship would give him ample exercise; merely conveying the candles and different things that were daily required on board fully occupied him outside the ship.

369. (*Admiral Inglefield.*) In your report you say that James Shepherd was taken ill with scurvy on the 3rd of January; had he been employed on any sledge travelling?—No.

370. Then he had not actually experienced so much exertion as other men in the ship?—No.

371. In fact he might have been called an "idler," his duties requiring service between decks?—Yes.

372. (*Dr. Donnet.*) Would you kindly describe the nature of the employment, and how were you able to ascertain that every man took the proper exercise?—By the routine; it was compulsory on everybody in the ship to attend at divisions at 9 a.m.

373. (*The Chairman.*) Were any special measures taken in regard to the personal cleanliness of the men by means of periodical washing or bathing?—Each mess, of which there were six, had one night a week for washing themselves, being excused evening inspection for the purpose. The allowance of water was two gallons per man, which was warmed for the purpose.

374. Was there any special place assigned for the purpose?—A small screened place, before the dispensary, on the starboard side of the lower deck forward.

375. Were any special measures taken in regard to a periodical change of clothing and washing clothes?—The dress of the day was ordered, and Sundays was always different from any other day. With regard to the washing regulations, the officers and ship's company were divided into four divisions; each division had a washing day for clothes once a month, so that each person on board had an opportunity of washing his clothes once a month. They were excused from after dinner for the purpose, and according to the routine Monday was the day.

376. And these regulations proved sufficient for the purpose of ensuring personal cleanliness?—Yes.

377. (*Admiral Inglefield.*) In former expeditions, bathing has been adopted and found afterwards to have no special advantages. Did you continue with the same regularity your bathing till the end of the winter?—Yes; and I believe it was looked forward to as a luxury.

378. (*Dr. Donnet.*) In the ablutions of the men were they provided with warm water?—Yes; the chill was off it as much as the consumption of coal would allow.

379. Was any part of the ship set aside for drying clothes, and, if so, at what temperature was that kept and by what means were you able to keep up the temperature?—The fore part of the lower deck, commonly termed the sail-room, was used as a drying-room. A small stove, known by the name of "bogie" in the service, was used for drying purposes.

380. Did the vapour that issued from this room interfere with the comfort of the ship's company?—Not at all; it was bulkheaded off, and a shaft of a spare steam pipe was passed through the topgallant forecastle and upper deck into the sail-room, a fire having to be lit under this ventilator, and when once aired it carried off all vapour.

381. (*The Chairman.*) Describe the mode which you adopted for cleaning the lower deck?—The lower deck was cleaned every morning in the usual way. The deck was varnished, but the tables and deck were scrubbed in the ordinary way. The deck was previously varnished before we left England, and the tops of the lockers, as we had no stools, were covered in carpet. Then, once a week, namely, on Saturday, the ship below was thoroughly cleaned.

382. What do you mean by "below"?—The lower deck, store-rooms, sail-room, passages, ward-room and ladder ways.

383. Then was the lower deck scrubbed with warm water daily?—It was generally washed with warm water, scrubbed and cleaned as dry as possible; but the condensation on the lower deck was so great throughout the winter that it frequently had to be dried up at other times of the day.

384. (*Admiral Sir R. Collinson.*) Were any deck cloths used?—Yes, painted canvas in the week days and matting on Sundays.

385. Throughout the whole of the deck, or only in the passages?—Along the gangways, fore and aft.

386. How were these cleaned?—Matting was brushed and canvas the same, except when it was wet, when it had to be dried.

387. (*Admiral Inglefield.*) It is the custom now in the service to coat the metal work between ship's decks with a composition of cork to prevent condensation; were the ships of the arctic expedition so fitted?—No; all iron work between decks was covered in leather.

388. Did you suffer much from the condensation on metal work then?—No, because there was very little uncovered.

389. (*The Chairman.*) Proceeding to paragraph 6: "A periodical monthly examination of the ship's company, after being settled in winter quarters, should be carried out, as the earliest signs of debility or scurvy will be readily detected thereby, and imme-

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diate measures may then be taken to arrest it." And in connection with that No. 11: "The use of lemon juice when travelling should be enforced in the same manner as already recommended for the men on board the ship." What periodical examinations of the men had you during the period you were in winter quarters?—Dr. Ninnis made a monthly inspection, and frequently oftener when he thought there was any occasion.

390. In your report, at paragraph 99 (and therefore I presume towards the end of February), I observe you state that the people all looked pale and blanched. Did this pallor and blanchness increase as the winter advanced?—I presume it did, but owing to the darkness it was not noticeable; and why it is here remarked in paragraph 99 is, that this was the returning daylight which made it so very remarkable.

391. Was this appearance of pallor and blanchness accompanied by any marked debility?—None, but rather the reverse; as the daylight came back spirits and energy seemed to return with it.

392. (*Admiral Sir R. Collinson.*) I see that at page 8, paragraph 93, you say that the stars were visible at noon for 109 days; therefore, for more than three months you were in total darkness, with the exception of the moonlight?—Yes; but it must not be lost sight of, that both in the declining daylight and also the returning daylight there was a large arch of dawn extending over the southern horizon, so that you could hardly call it pitch dark during the whole of that time. On the 16th of October we lost the sun, but we did not have darkness. I do not think I noted the day that we first saw the stars visible at noon during the autumn. Only perhaps one or two stars of the first magnitude were visible on the 16th of February at noon.

393. (*Admiral Inglefield.*) How often did you communicate with the "Alert" during the time you were separated? I think that the 18th of April to the 23rd was the first time you went yourself; you were absent for five days?—The first was Lieutenant Rawson's party, who came on the 26th of March, I think. They left on the 30th of March, taking the first letter with them; and then Lieutenant Beaumont left the ship on the 6th of April with two sledges for the North Greenland party, and then I left on the 18th of April and returned to my own ship on the 4th of May; and then Sub-Lieutenant Conybeare left, taking the last but one of the letter proceedings on the 22nd of May. I communicated with the "Alert" four times.

394. I see that James Hand was the first man that died of scurvy belonging to your ship, on June the 3rd. Was he the first man that died in the expedition?—I believe he was. I do not know the date of the "Alert's" deaths.

395. How many men had you altogether that died of scurvy?—Two.

396. James Hand and Charles Paul?—Yes.

397. (*Dr Fraser.*) I think you have noted in your report that the sun was absent from the 16th of October, 1875, to the 29th of February, 1876. This, therefore, I suppose, constituted the darkest period?—Yes.

398. How many of the cases of scurvy in your crew occurred during that time?—One during that time.

399. That was the case that we have already spoken about, the case of Shepherd, I think?—Yes.

400. And besides this case, you had 15 cases of scurvy connected with your crew?—I believe that is the number, but I am not sure.

401. Only one case, therefore, occurred in the darkest period, while about 15 occurred at other times?—Yes.

402. Bearing those facts in mind, do you think that the absence of light was a cause of scurvy?—Possibly.

403. Do you think the fact that one case occurred in the dark period and 15 in the lighter period lends any support to the idea that the absence of light was a cause of the attacks of scurvy?—It may be attributed to it in some measure.

404. Can you give any reasons for such an opinion?

—I consider that the scurvy was to be attributed to many causes, not only to the absence of light.

405. At any rate, from these facts, it would not appear to have been the most important cause?—No.

406. You have told us that you noticed towards the end of the period of darkness that the complexion of your crew was somewhat altered. Can you describe the change which you observed?—With the exception of looking blanched, I could observe no material difference in them.

407. Their physical strength did not appear to be diminished?—Apparently not, from the way in which they dragged the sledges.

408. Did you observe any injurious effect that had been produced on your crew by the absence of light?—No, with the exception of the extreme satisfaction that the returning daylight seemed to give to everybody.

409. Returning again to the case of the cooper, James Shepherd, how did his case terminate; did he recover or did he die?—He recovered.

410. Two cases which occurred in the lighter period proved fatal, however?—Yes.

411. Before James Shepherd's illness, at the commencement of January, I think you have told us that during all the time he had been under your observation, he had enjoyed good health?—As far as I can recollect.

412. He took what, in your opinion, was sufficient exercise at that time?—Yes.

413. He had not been subjected to any excessive physical exertion?—No.

414. Can you tell us whether he took exactly the same diet as was at that time issued to the crew?—I can only give hearsay evidence in the matter. I have been told that he preferred his salt meat ration to either the preserved meat or musk ox.

415. From whom did you obtain the information?—From inquiring of his messmates, who, I believe, informed Dr. Ninnis.

416. Can you give me the number of his mess?—No. 5.

417. Had you any reason to suppose that he did not take the ordinary ration issued of lime juice?—No; on the contrary, I am convinced that he did.

418. This man recovered, I think you have told us?—Yes.

419. Do you know if, during his treatment, he certainly consumed vegetables?—Yes, certainly.

420. The other cases that you have referred to did not occur on board ship?—No.

421. Where did they occur?—In the sledging parties.

422. So far as the dietary of these sledging parties seems to you to be one designed to support physical strength, do you think it properly arranged for that purpose?—Yes.

423. Still, the physical strength of a considerable number of those who consumed the diet was not supported?—Yes.

424. Do you think that in this dietary the solid food was in sufficient quantity for the men?—Yes; because it was not always all consumed.

425. (*Dr Donnet.*) Did you attribute the pallor of the men to the absence of light?—I think I did. I do not know of any other cause.

426. Were the men as strong and in as good health in spring as they appeared to be before the disappearance of the sun?—Apparently in just as good health.

427. The greater number of the men attacked with scurvy fell ill after the reappearance of light, 109 days darkness having elapsed since the autumn. Can any importance be attached to this fact?—I suppose it is to be attributed in some measure to it.

428. (*Admiral Sir R. Collinson.*) What was the principal cause of the scurvy, in your opinion?—I think it is to be attributed to many causes.

429. Will you state what those causes are?—I consider the hard work and exposure of sledging in so severe a climate, after the long dark winter and damp

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lower deck, are sufficient causes to account for its outbreak.

430. Were any of your own sledge crew attacked with scurvy?—My own sledge crew consisted of two men and the dog-sledge, one of whom was my servant; although I was frequently away sledging with larger bodies of men, I cannot call them my own sledge crew, as they had been employed previously on long sledging journeys.

431. Your sledging party was dispatched early in the spring to Lady Franklin Sound; on their return, were any of those men attacked with the scurvy?—To the best of my belief none with scurvy, but one marine had a scorbutic taint and was not allowed to go on further sledging journeys.

432. Then the attack of scurvy which happened to the sledge parties belonging to the "Discovery" made its appearance in those sledges which were detached to the coast of Greenland?—Yes.

433. They were absent a long time from the ship?—Yes, an absence of over four months.

434. Do you consider that the dampness of the clothes of the men, when they went to bed for the night, had an effect in producing this disorder?—I think it had in some measure.

435. (*Admiral Inglefield.*) After your recent experience, have you any suggestions that you could make so as to avoid as far as possible the outbreak of scurvy on any future expedition. Is there anything that you can say with reference to the equipment and fitting of the vessel, and the lime juice carried on a sledging party?—I am of opinion that if there had been no sledging, or no very hard work, we might have returned without scurvy having broken out amongst the ships' companies; but I am of opinion that it belongs to arctic service.

436. Do you consider that your vessel, the "Discovery," was fitted in the most perfect manner you can suggest?—In the most perfect way that is possible. There are many suggestions that I could make, but I do not see my way to carrying them out.

437. Roundly, will you name them?—Such as more cubic space for the men to live in. I consider that the lower deck was small for the number of people that were living on it, because the same dampness that was so bad to them was not experienced in the same degree in the ward-room or the officers' cabins, nor did I ever experience any condensation in my own cabin, and that must be attributed to having more cubic space.

438. Can you give the Committee an idea of the cubic space per man?—No, but Dr. Ninnis has full particulars under that head.

439. The condensation doubtless, then, is due to the breath of the men?—Yes, and it was always worse on the lower deck during the actual issuing from the coppers; cocoa in the morning, soup in the middle of the day, and tea in the evening.

440. Can you inform the Committee of the difference of the temperature between your cabin and that of the lower deck?—I hope to be able to give the Committee a list of temperatures of the lower deck to-morrow; but, speaking from memory, the average temperature of my cabin was 48 to 56, and about the same as the lower deck, the lower deck having a larger range, from 48 to 66, or 46 to 66.

441. (*The Chairman.*) With reference to the second paragraph, which I read to you just now, regarding the lemon juice; will you state why lemon juice was not included in your sledge dietary?—It was not considered necessary just at that time. The men were all previously medically examined before starting away from the ships, and they were in excellent health. There would have been a great difficulty in carrying it, had we taken into consideration how it was to be stowed. At the temperature when the first sledging crews left, it could never have been got out of the bottle, and later on, when the weather became milder, it would all have run away if they had broken the bottle previously; in fact, we had no means of carrying it.

442. I presume the use of lemon juice on the sledge journeys formed a subject of serious consideration between yourself and Sir George Nares, and also with the medical officers of both ships; was that so?—I do not recollect ever having a conversation with Sir George Nares particularly on this subject; and, as far as my own memory serves me, I never contemplated that scurvy would have attacked the sledging crews in the way it did.

443. Was the dietary of the sledge crews belonging to the "Discovery" decided on by yourself alone, or in concert with Sir George Nares?—The dietary of the sledge crews was, I believe, decided upon by the Arctic Committee.

444. And were the medical officers of the respective vessels consulted by yourself and Sir George Nares in regard to this dietary?—I do not think that they were in a general way, although I freely discussed the matter with Dr. Ninnis of my own ship, but I never was at a consultation held with Sir George in the presence of both the medical officers on the subject.

445. So that you were fully in possession of the opinions of both the medical officers of your ship on the subject?—Yes, with Dr. Ninnis'.

446. (*Admiral Sir R. Collinson.*) With respect to the medical stores which were carried by the sledge parties, by whom were they arranged?—By the surgeons of each ship respectively.

447. Were any instructions given to the commanders of the sledge parties for their administration?—Yes, full instructions and explanations of what was to be done.

448. Are you personally acquainted with those instructions?—Yes, perfectly.

449. Was there any instruction especially with respect to scurvy, if it made its appearance?—No; with the exception of the case of John Shepherd, on board the "Discovery," during the winter. Dr. Ninnis told me that it was of the utmost importance that all the officers should see this man's state, and see what scurvy was, in case of its breaking out. That is the only occasion, I think, on which it was mooted.

450. Then nothing was provided in the medical stores especially for the treatment of scurvy during the absence of the sledges from the ship?—Not for scurvy, that I know of. We had the usual liniments, bandages, and so forth, for stiff legs, which was the way scurvy first showed itself; but the only recommendation in case of scurvy breaking out, was complete rest and change of diet where it was possible.

451. And no notice, made by the medical officers, of lime juice, appeared in those instructions?—I think not.

452. (*Dr. Fraser.*) Have you a copy of these instructions?—Not here.

453. Can you supply the Committee with a copy?—Yes. (Appendix No. 12.)

454. You, however, had the suggestions and recommendations of the Director-General of the Medical Department?—Yes.

455. Were they officially communicated to you?—Yes.

456. Is the letter by which they were communicated published in your report, or elsewhere?—Not in my report.

457. Is it published anywhere?—Yes.

458. To what extent did you think these recommendations and suggestions of the Director-General's binding upon yourself?—I think it was a suggestion to the captains and the medical officers to bear in mind these facts, and to carry out as far as possible these suggestions, which his experience had compiled; and I am under the impression that these suggestions have been carried out as far as practicable.

459. I observe that paragraph 11, which we are now considering, is to this effect: "The use of lemon juice, when travelling, should be enforced in the same manner as already recommended for the men on board the ship." Having heard this quota-

tion read, do you still adhere to the opinion that the recommendations were carried out?—As far as they were able to be carried out.

460. Can you inform the Committee who drew up the dietary for the sledge parties?—I believe the Arctic Committee, before leaving England.

461. Then it was prepared, not on board ship, but in this country?—I am under the impression that it was.

462. Can you recollect how it was first brought under your notice?—By the scale being sent on board my ship from Sir George Nares, with further instructions and details concerning sledge travelling in general.

463. So far as you remember, therefore, the dietary of the sledge parties was drawn up in this country by the Arctic Committee?—I am under that impression.

464. I understood you to say that the sledge parties' diet list was, however, submitted to the medical officers on board your ship; am I right?—I think the dietary list was fully discussed by the captains and the medical officers, in planning the work of the exploring parties. But the question of lime juice did not attract our attention so much as it has apparently in England. I forget what conversation did take place on the subject.

465. I think you told the Committee that the introduction of lime juice into the sledge-parties' dietary was not made, because it was not considered necessary at that time?—I think that is so.

466. By "at that time," do you mean at the time during which you were preparing your sledging parties or considering their equipment?—At the time they were preparing the sledging parties.

467. In what month might that be?—In the months of March and April.

468. Previous to that time, however, had you not had a case of scurvy?—Yes.

469. Still, the danger did not then occur to you; one case did not suggest the danger?—No. The Medical Director-General had told me, before we left England, that the chances were that scurvy would not break out the first winter; we might possibly have it the second winter, and would be almost sure to have it the third winter.

470. Still, the Medical Director-General, in his official communication, has expressed the opinion that the use of lemon juice when travelling should be enforced. I understand you, therefore, that this paragraph was not fully considered by you in preparing your sledge parties?—I do not think we attached the same importance to it as the Director-General has. In fact we had no convenient means of carrying it.

471. Returning to a previous part of the examination; at that time, that is to say, when you were equipping your sledges, you did not consider it necessary to carry lemon juice. What is now your opinion on the subject?—I do not see, under present circumstances, how it could be carried, and I have always been taught to understand that lime juice is an antiscorbutic, but does not always prevent scurvy from breaking out; but this is a medical question.

472. You mean by that, that it is a preventative of the disease, and not a remedy to employ in the existence of the disease?—Yes; but this is a medical question.

473. But you had no scurvy in your sledge parties when they started?—No.

474. Then if lime juice were carried by the sledge parties, it might have been carried as a preventative as much as a remedy?—Possibly it might.

475. You think it only valuable as a preventive, and if you had carried it on the sledge parties you would have carried it as a preventative?—Yes; this again is purely a medical question.

476. Then the mere fact of its being a preventative was not the reason why you did not carry it?—I have already stated that we had no means of conveying it, and it was considered at that time unnecessary.

477. But, with the experience which you have since acquired, are you now of opinion that it is necessary

as an addition to the dietary of sledging parties?—I think I should be inclined in future cases to send lime juice to depôts in laying out rations for advanced sledge exploration, but I do not see how it can be carried in the form it is at present supplied.

478. To what use would it be put in the depôts?—It might be issued to the men there on their arrival and departure, and also relieve sledging parties who happened to suffer from that disease.

479. But I thought your opinion was that it is not a curative agent, but only a preventative agent; therefore, what benefit would you expect to derive from its administration in cases of scurvy where the disease is already present?—We found that it was a great assistance to the sledging party at the "Polaris" depôt, when they were brought in suffering from scurvy.

480. Then in that case it did not act as a preventative?—I suppose it assisted, with other things, as a curative in this case; but this is a medical question.

481. At what distance are the depôts generally from each other?—There is no fixed rule.

482. In the sledging parties of the "Discovery," at about what distances were the depôts separated from each other?—An eight-man sledge will carry about 42 days' provisions, and that would be 21 days out and 21 days back to the depôt.

483. Is that somewhere about the usual distance?—Yes, talking roughly. Sometimes they are only 10 days apart.

484. Ten days being about the shortest distances?—There were some depôts that were within five days. The great object in exploring a country satisfactorily is to have plenty of depôts. You cannot have too many depôts of provisions fixed about the country.

485. Was this five-days' distance between the depôts in connection with any special sledging party?—There was a large depôt on the Polaris Bay, the coast of Greenland, which was a five-days' journey across Hall's Basin, consisting of 1,000 rations nearly. That was the base of the North Greenland exploration party.

486. From what you have told me the depôts were at distances of 21 days' journey, 10 days' journey, and 5 days' journey?—Yes, they varied as circumstances allowed; but it was to our interest and to the interest of the sledging parties to have the depôts as near as possible.

487. On arriving at a depôt what length of stay did you make?—Generally there was no time wasted. The officer opened the depôt, taking the things he wanted, leaving a list of what he had taken, and proceeding on his journey. But there were always clear and defined orders left as to what steps were to be taken.

488. The halt at a depôt, therefore, was a mere matter of a few hours?—Yes.

489. Then do you think it would have been of any value to the extended sledge party, that the men employed in that party should have had issued to them rations of lime juice at intervals of 21 days, 10 days, and in some cases 5 days?—I am of opinion, now, from the experience which I have had, that a sledging party once attacked by scurvy ought immediately to return to their ship, however slight the disease may apparently be.

490. But for the purpose of preventing the sledging party from being attacked, if lime juice possesses any value in doing so, do you think it would prove serviceable if administered at intervals of 21 days, 10 days, or 5 days, as you suggest?—That is more a medical question. I am unable to give an opinion on it.

491. Then your experience on the subject has not led you to the conclusion that lime juice is an essential requisite for sledge parties, as we have been told by a previous witness?—The attack of scurvy which happened to the sledge parties may possibly be attributed to the want of lime juice.

492. But if it may be attributed to the want of lime

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juice, would it not be important in future to carry lime juice?—Yes, it might be.

493. Now, if it be important to carry it, and if you had arrived at that conclusion previously to the equipment of your sledge parties, and considering the dietary adopted for those sledge parties, can you suggest any alteration in that dietary which would have enabled you to carry the requisite quantity of lime juice?—I have not had sufficient time to weigh the matter.

494. If lime juice be at all valuable in preventing scurvy, do you think that it was a more or less important article in the dietary than the somewhat large ration of rum?—I would not give up the ration of rum for the sake of carrying the same allowance of lime juice.

495. Could your sledging parties have existed comfortably, and, as far as you know, in good health, with a smaller quantity of sugar than they had served to them?—Yes.

496. Had it been your opinion that lime juice was a very essential and important article in the dietary of the sledging parties, you might have either reduced the quantity or altogether dispensed with the sugar in the present diet list, and substituted in its place the necessary quantity of lime juice?—I was not of opinion then that lime juice was so essential to the health of the sledging parties as it now appears to be.

497. (*Dr Donnet.*) Then do I rightly understand you to say that lime juice was not considered absolutely necessary to be taken in sledging journeys?—Yes; at the beginning of the sledging season that year that was my opinion.

498. In the ship to which you belonged was lime juice always served out as an allowance to the ship's crew in accordance with the instructions?—Yes, it always had been.

499. Did you know the object for which lime juice was given in those ships, and were you aware that it was given to preserve the men from attacks of scurvy?—Yes.

500. May I ask you whether you are acquainted with the great immunity which the navy has enjoyed since 1795, when lime juice became a regular ration of the navy, and that at the present day scurvy is scarcely known in the navy?—Yes.

501. With the light of your present experience, would you attempt to perform a polar sledge journey without the precaution of taking lime juice as a daily ration?—I should certainly recommend lime juice to be carried or left in dépôt at convenient places.

502. Would you not consider it an absolute necessity to take it on a sledge journey after the experience which you have now had?—Yes.

503. In answer to Dr. Fraser's question, you say you would not give up the ration of rum for the purpose of substituting that of lime juice; do you attach so much importance to the use of spirits on sledge journeys?—I think the ration of rum was necessary and most acceptable at the end of a day's sledging.

504. If obliged to give up one, which of the two would you set aside?—From my previous experience I should say the rum; that is, on those conditions only.

505. (*Admiral Collinson.*) What was your lime juice carried in on board the "Discovery"?—In glass bottles covered with wicker.

506. When you heard that the Greenland party were attacked with scurvy you went over to Polaris Bay with medical comforts?—Yes.

507. Did you carry any lime juice with you?—No, knowing there was an ample supply over there.

508. Do you know whether the party had recourse to the two casks of lime juice left there by the Polaris?—Yes.

509. And that it was used by them?—Yes, freely.

510. At that period the sun having come further north, you would probably have carried the lime juice without freezing in the bottles covered with wicker?—Yes.

511. Earlier in the year do you think that would have been possible?—Yes, but not for use.

512. Were the casks of lime juice left by the "Polaris" buried?—No.

513. Have you reason to suppose that they were frozen during the winter?—I suppose they were.

514. What sized casks were they?—Large wooden casks, I should suppose, of about 32 gallons.

515. At the "Polaris" dépôt there was a sufficient quantity of fuel, was there not, so as to render the supply of water not a difficulty?—There was no fuel but what we sent over from the "Discovery."

516. The water had not begun to run when you went over there?—I went over twice, but in the early part of the year, there was no water there.

517. But there was fuel there, so that they could get any supply of water they pleased?—Yes, during the time the North Greenland party was there with the sick men; that was in the summer months, June and July.

518. When Commander Beaumont left, if he had taken lime juice he would have been obliged to carry an extra quantity of stearine?—Yes.

519. (*Admiral Inglefield.*) Do you feel satisfied that all the men took their rations of lime juice while on board, and was it the custom in the "Discovery" to permit the men to take any portion of the issue to their messes?—I am sure that all drank their lime juice; it was most popular amongst them, and it was certainly not permitted for any of them to take it away from the tub.

520. Was there any occasion when they were given a double allowance of lime juice, as in the "Alert"?—Yes.

521. And it was all drunk at the tub, was it?—Yes. I am under the impression that the same regulations were carried out for the double issue as were for the single.

522. Do you see any reason why lime juice might not have been mixed with the tea while sledging, and thus have issued lime juice regularly, without necessarily adding to the weights to be carried, at least as regards extra fuel?—I see no objection beyond making the tea very unpalatable, and I should say impairing the efficacy of the warm draught in these regions.

523. (*Dr. Fraser.*) Are you aware that, as a matter of choice, in various parts of the world, lime juice is added to tea?—Yes, in warm climates.

524. Do you still think the effect is to make the tea unpalatable?—I am under the impression that in those regions I should not have preferred tea mixed with lime juice.

525. But if this were the only method of administering to your men what might have been an important preventive of a very serious illness, the mere idea that the mixture would be unpalatable would not deter you from insisting upon its use?—Certainly not.

526. You have told the Committee that in one of your sledging excursions you found lime juice at a dépôt which had been left by the "Polaris," how long had it been there?—Five years.

527. Uncovered?—Yes, uncovered.

528. Therefore, necessarily, it had been frozen frequently?—I believe so.

529. Was it used by any of your crews when suffering from scurvy?—Yes.

530. So far as you are aware did it prove efficacious as a remedy?—I believe so.

531. Then it is not your opinion that the mere freezing of lime juice destroys any power which it may possibly possess in preventing or curing scurvy?—I do not think so.

532. (*The Chairman.*) Can you supply the Committee with the following returns: First, A list of captains of messes, showing rating, and whether captains of sledges. Secondly, Return of savings during the period the ship was in winter quarters, exclusive of those of the officers. Thirdly, Temperature return, showing the daily temperature on the lower deck and

alongside during the winter. (Appendix No. 14).
Fourthly—Return of the physical condition of the
officers and men required for sledging, made by the

medical officers of the ship previous to starting, if
any? (Appendix No. 13).—Yes, I will furnish those
returns.

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The witness withdrew.

Adjourned to to-morrow at 11 o'clock.

SATURDAY, 13TH JANUARY, 1877.

PRESENT:

ADMIRAL SIR JAMES HOPE, G.C.B., in the Chair.

ADMIRAL SIR R. COLLINSON, K.C.B.

VICE-ADMIRAL E. A. INGLEFIELD, C.B., F.R.S.

JAMES J. L. DONNET, ESQ., M.D., Inspector-General of Hospitals and Fleets, R.N.

THOMAS R. FRASER, ESQ., M.D., F.R.S.E.

H. J. VANSITTART NEALE, ESQ., Secretary.

CAPTAIN ALBERT HASTINGS MARKHAM, R.N., *examined.*

533. (*The Chairman.*) On what day did you join
the "Alert"?—On the 15th April, 1875, the day she
was commissioned.

534. And you belonged to her till she was paid off?
—Yes.

535. In what condition do you consider her
crew to have been when the ship was laid up for the
winter?—I considered them in perfect health.

536. In what condition did you consider them to
have been when the spring sledge journeys were on
the point of commencing?—Also in perfect health;
those who were engaged in the sledging operations.

537. Can you state any special grounds on which
you base these opinions?—No; I have no reason to
believe that they were otherwise than in good health.
They appeared a little sallow, which I attributed
entirely to the long winter and the darkness that we
had gone through, but I certainly considered the men
in perfect health from their appearance and from the
work which they were able to do.

538. Will you state your opinion as to the suffi-
ciency or otherwise of the dietary on board the ship
from the day she left England until the spring sledge
parties left?—I considered it to be very good, and one
that we could not improve on.

539. In a memorandum of suggestions and recom-
mendations as to the health of the Arctic Expedition
of 1875-76, by the Medical Director-General of the
Navy, there is one recommending a double allowance
of meat per diem. We have had it already in evi-
dence that the men could not have consumed the
additional quantity recommended: do you confirm
that opinion?—Quite so. I know that the allowance
was not consumed.

540. Do you consider the dietary prescribed for the
sledge parties to have been in every respect sufficient,
reserving the question of lime juice?—Quite.

541. (*Dr. Fraser.*) You have said that you con-
sidered the dietary quite sufficient for the sledge
parties; on what do you base that opinion?—From
the amount that was unconsumed, and the general
contentment of the men and myself. We always
felt that we had enough.

542. That is to say, there was sufficient bulk of
food?—Yes.

543. You express in that case no opinion as to the
quality or the relative proportions of the different
constituents in the dietary?—I consider it excellent,
and that it could not be improved on for sledging
purposes.

544. I believe you have had, previously to this
expedition, some experience in arctic regions?—Yes,
one summer.

545. Have you any opinion as to the necessity for
a considerable proportion of succulent vegetables, or
of some substitute, in the dietary for arctic regions,
confining yourself now to sledging parties?—If they

could be carried and cooked, vegetables would cer-
tainly be an improvement: preserved potatoes were a
part of our dietary.

546. I hold in my hand a diet list contained in a
report from Captain Nares, and may I take it for
granted that that is the diet list which you used in
your expedition (*handing a paper to the witness*)?—Yes;
that is quite correct.

547. Can you tell us if the bacon which is
marked there, generally contained a large quantity of
fat?—Yes; a great deal.

548. It is noted that in some cases the 4 oz.
of bacon mentioned in the scale was increased to
6 oz. "at request, and in lieu of pemmican." May
we understand from that that no pemmican was given
when the bacon was increased to 6 oz.?—The allow-
ance of 6 oz. of bacon was only given when preserved
meat was taken in lieu of pemmican, and that only
in the autumn.

549. Then this diet list was not rigidly adhered to
throughout the sledging expeditions?—It was for
the spring sledging; for the extended parties in the
spring.

550. The quantity of potato which was given
appears to have been 2 oz. per diem. Can you tell us,
from your actual knowledge, if, in every case, that
quantity was consumed by each member of your
crews daily, until they were disabled by disease?—
It was always cooked with the pemmican, and served
out with it; if they eat their pemmican, they were
bound to eat the potatoes.

551. There is an entry of onion and curry powder,
 $\frac{1}{4}$ oz.; was this likewise consumed daily?—Yes.

552. Mixed also with the pemmican?—Yes.

553. This dietary was used only by the sledging
parties in the spring; previously to that time, how-
ever, there appear to have been various excursions
from the "Alert," with which you yourself were con-
nected; what dietaries were used on those other
occasions?—The difference was New Zealand beef
in lieu of pemmican, a pound and a half of which, I
think, we took per diem; six ounces of bacon instead
of the four, and half the amount of tea and sugar.

554. These expeditions, previously to the spring
expeditions, were tolerably numerous, but, so far as I
understand, they did not last for more than three or
four days; is that so?—No. I was away for twenty
days at one time, and four at another, in the autumn;
and Lieutenant Aldrich, on two different occasions,
was away for fourteen days, and, I think, four days.

555. The purposes of these expeditions were
generally to explore the country in the neighbourhood
of the "Alert," and to form depôts of provisions and
stores, were they not?—Yes, to explore northwards,
and to advance depôts of provisions.

556. Can you tell us what provisions you generally
collected in those depôts?—The depôt that I laid out

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in the autumn consisted entirely of pemmican and bacon, I think 1,500 lbs. in weight.

557. Did you not form other depôts?—No, the only other work was that of advancing two boats.

558. Is it within your knowledge that any other articles were collected in depôts besides those to which you have referred?—Not to any extent, not more than one or two days' provisions at the most for eight men.

559. Were there no medical stores or comforts?—None.

560. Can you tell us generally what was the state of the health of your exploring parties previously to the expeditions in April?—I considered them in excellent health.

561. They had frost bite, however, had they not?—Yes; but those cases were not engaged in the extended exploring parties. I am referring to several cases of frost-bite, those which resulted in amputation.

562. In those exploring parties previously to the spring, were the men generally supplied with good drinking water?—Yes.

563. I understand that you commanded the northern sledging party?—Yes.

564. Previously to the start of the northern party, you did establish depôts in the hope that they might be useful during the exploration?—I established a depôt of provisions on the land, whence I took my departure on the ice.

565. The provisions collected in this depôt were the same as you have already told us?—Yes, bacon and pemmican.

566. On what date did you start on your northern expedition?—On the 3rd of April.

567. I believe you had several parties under your command on starting?—Yes.

568. Would you tell us what parties?—The whole party were under my command until we parted company near Cape Joseph Henry, in fact, at the depôt of provisions that I had established during the autumn, seven sledges in number and 53 officers and men.

569. So far as you were able to judge, these 53 officers and men were on the 3rd of April in excellent health?—Yes.

570. Can you tell the Committee what weight each man was expected to drag on starting?—Not more in my party than 236 lbs. per man, but Lieutenant Aldrich's two sledges were, I think, pulling about 240 lbs. per man.

571. These weights were in some, if not in all, cases greatly increased latterly, were they not?—Yes, owing to the outbreak of scurvy, which weakened our force and necessitated our carrying several of our companions.

572. I observe from your journal that there is no note of any sickness among the men until the 6th of April, when you note that some of the "Challenger's" men were "seedy"?—Yes.

573. That, however, was not a very important illness, I presume?—Two of the men, on the recommendation of the medical officer, were sent back with the supporting sledges who would otherwise have been with the extended parties.

574. Can you tell us the names of those two men?—James Berrie, ice-quartermaster, and Elias Hill, gunner of the Royal Marine Artillery.

575. They were sent back on the recommendation of the medical officer; what medical officer was that?—Dr. Moss, who commanded one of the supporting sledges.

576. Did he inform you of the nature of their ailments?—He did not, that I can recollect. I considered it general indisposition.

577. On April the 14th you note that a man named John Shirley was complaining of illness?—Yes.

578. Did that illness subsequently prove to be scurvy?—Yes.

579. Was this the first occasion on which John Shirley made complaints during that journey?—Yes.

In the autumn, however, whilst with me sledging, he had to be carried on the sledge from exhaustion.

580. The 14th of April, I think, would be 11 days after you started?—Yes.

581. Can you tell us when next any of your party complained of illness?—On the 16th.

582. And then what man?—George Porter, of the "Victoria" sledge.

583. Did his case subsequently prove itself to be scurvy also?—Yes; he died from it.

584. Did either Shirley or Porter exhibit any physical disability previously to these complaints of illness from them?—No; they simply complained of pain in their ankles and knees, but they were able to walk.

585. On the 14th of April I presume you had abundance of light?—Yes.

586. Any change in the complexion of these men might therefore have been readily observed?—I think we were too dirty to observe it. I certainly observed none.

587. On the 17th I think you had another case?—No, I think not, except a case of frost-bite.

588. Would you mention what man that was?—Alfred Pearce, able seaman, of my sledge.

589. Did he not afterwards exhibit decided symptoms of scurvy?—Yes.

590. Then, so far as you know, the scurvy may have commenced on the date we are speaking of?—It may have.

591. I think from the 3rd of April up to the 17th of April the men had not been on a full allowance of pemmican?—No.

592. Why was that?—Because on first starting the men do not eat their full allowance, and it was thought expedient, for the purpose of saving weight, not to take it.

593. Then the next case, I think, occurred on the 25th of April?—Yes.

594. What was his name?—James Hawkins, cooper.

595. What symptoms did he exhibit?—Swollen ankles.

596. Your next case appears to have been on the 2nd of May?—Yes.

597. What was the name of that patient?—Reuben Francombe, able seaman.

598. Had you by this time recognised the disease?—No, I think not up to that date. It is stated in my journal when we did so. It was only a supposition on my part, which was not at the time concurred in by Lieutenant Parr. I had had no experience of scurvy, nor did I anticipate it.

599. You suspected it, however, in Porter's case?—Yes, on account of his teeth and gums.

600. Were you supplied with any memorandum or notes containing a description of the earlier symptoms of scurvy before starting on the expedition?—No, I was supplied with medical instructions by Fleet Surgeon Colan, the principal medical officer of the ship, but scurvy was not mentioned.

601. Can you produce those instructions?—I will produce them. (Appendix No. 19.)

602. When did you become satisfied that these somewhat numerous cases were cases of scurvy?—On May the 9th.

603. What led you then to feel certain that it was scurvy?—I could not think it was anything else, from their loose teeth and sore gums and utter prostration. I could not attribute these symptoms to any other disease.

604. You had noted loose teeth and sore gums in connection with these cases previously, I think, as well as prostration?—In one case, I think.

605. But it was the number of cases in which those symptoms occurred which satisfied you that it was scurvy?—Yes.

606. Were there no discolourations of the skin anterior to the 9th of May in any of the cases?—Yes, there were.

607. But not having been provided with any

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description of this disease, you were not satisfied from these symptoms that it was scurvy at that time?—No, I was not.

608. Having been satisfied, did you at once commence to treat these cases in any special manner?—Yes, by issuing lime juice.

609. You took some lime juice with you yourself, did you?—I did.

610. What quantity did you carry with you?—I had four ordinary quart beer bottles full of lime juice.

611. Can you give the Committee any idea of your reason for supplying yourself with these four bottles of lime juice?—Captain Nares recommended it, and I thought it would be a good thing, but not dreading scurvy.

612. You mean that you thought it a good thing should scurvy occur, although you did not dread scurvy?—No; a good thing for the men to drink to quench their thirst when the weather became warm, and we could obtain water more as a luxury than anything else.

613. Still, having these cases under your care, you thought it advisable to administer lime juice, and I find that you note in reference to that lime juice that it is an excellent antiscorbutic?—Yes.

614. You did not carry a sufficient quantity, did you, to serve out a ration to the men during the expedition?—Not a daily ration.

615. How many men had you in these two sledges?—Including the two officers we numbered 17.

616. Can you tell us if on May the 9th the weather was cold?—I see the temperature was about zero; it ranged from $+2^{\circ}$ to -8° .

617. The lime juice had been carried by you from the 3rd of April, during which time, I presume, the temperature was on several occasions below the lowest point you have named?—Yes.

618. Were the four beer bottles in which it was carried protected from the cold in any way?—No.

619. Were any special precautions taken to prevent their being broken?—No.

620. Then, as a matter of fact, they were not broken?—No; the first bottle, when required for use, on the 9th of May, was broken by attempting to thaw the lime juice over the fire.

621. What quantity of lime juice were you able from those four bottles to administer daily to your cases?—I used to give a little better than a quarter of a gill.

622. You did not, in fact you could not, afford to give it at that time as a general ration to your crews?—No; I gave it to those men who had exhibited scorbutic symptoms and in lieu of grog, issuing it at the same time.

623. Did four more men become ill of scurvy on the 9th of May?—They complained of stiffness of joints and of soreness of legs, but they were still able to do their duty.

624. And these four men afterwards developed obvious symptoms of scurvy, did they not?—Yes.

625. Had you any further cases between the 9th of May and the 28th of May?—On the 23rd of May, John Pearson complained of his legs, and all, more or less, complained.

626. By all, do you mean officers also?—Yes; our legs were aching, but we attributed it more to sleeping so long on the ice. By "our" I refer to Lieut. Parr and myself.

627. During the expedition you had no more obvious symptoms of scurvy than those you have mentioned, had you, before returning to the ship?—Discolouration. On my return I heard that Lieutenant Parr's legs also were discoloured.

628. Had your stock of lime juice become exhausted before the 28th?—Yes, the lime juice was finished on the 18th.

629. So that on the 28th the total force under your command was suffering from scurvy, including yourself and your colleague, to some extent?—Yes.

630. What was the number of officers and men?—Two officers, and fifteen men.

631. Did all these cases recover?—All but one, George Porter.

632. Some days after this you fortunately received relief, did you not?—Yes, on the 9th of June.

633. Who commanded the relief party?—Lieutenant May the advance, and Captain Nares the main.

634. They brought you provisions, and medical comforts, and medicines, did they not?—Yes.

635. Can you tell us what medicines and medical comforts they brought you?—I do not know what medicines Dr. Moss had with him, but the medical comforts consisted, so far as I can recollect, of port wine, champagne, brandy, backless chickens, calves-foot jelly, apple jelly, and some jams, I think, besides some geese and hares that had just been shot, and milk and lime juice.

636. Was the lime juice at once administered to the party?—It was.

637. During this expedition, which we have traced from its commencement to its close, can you tell the Committee what kind of drinking water you could obtain, and how you got it?—It was obtained principally from snow; but, as a rule, when we could get good ice, we preferred it.

638. Was it floe water?—Yes, I think that the ice which we used was formed entirely from the snow; was converted from snow into ice by pressure.

639. What is your opinion of the quality of the water which you obtained?—I always considered it very good. Once or twice our cook, inadvertently, made our water from brackish ice, which we drank; but only on one or two occasions.

640. Were you able to procure sufficient quantities of water?—No, we were only able to procure water for our meals.

641. You suffered, indeed, from the want of a sufficient quantity?—Yes; we suffered from thirst as a rule.

642. In fact, you had to melt, by means of your lamp all that you could get for drinking?—Yes, entirely.

643. Had you also to melt your lime juice?—Yes.

644. And also by means of a lamp?—No; after the bottle was broken, I used to thaw the lime juice in my sleeping bag by placing it between my legs.

645. Was this done with all the four bottles?—It was done with my sledge party, but I cannot answer how Lieutenant Parr thawed his. I think in the same manner.

646. You did not find it a very difficult matter to accomplish the thawing in the manner you have described, did you?—A very difficult matter, and I could only thaw in two or three hours a very small amount, and that was, I think, principally the spirit with which the lime juice was mixed. I was unable to thaw the entire bulk.

647. But, as a matter of fact, by this method you were able to thaw a sufficient quantity to give the doses that you have already told the Committee of?—Yes, to the patients.

648. Had you had a larger quantity of lime juice, and had the same method been adopted by other members of your sledge party, would it have been a possible matter to have administered daily rations of lime juice?—No.

649. Why?—Because, when we left the ship, and for the first three or four weeks, the temperature was so low that we could not have thawed it. The temperature inside my own sleeping bag was one night below zero.

650. That was in April, I presume?—That was for the first four weeks.

651. During the month of May, could you have given daily rations of lime juice to all the members of your sledge party by this process?—If each man had been supplied with a bottle, they would probably have been able to thaw as much as I was able to do.

652. How many patients were you able to supply on any one day by thawing it in that manner?—I think two or three.

653. Had the bottles been smaller than the bottles

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you have described, would it not have been an easier matter to have thawed the same quantity in the same way?—Yes, I think so.

654. (*Dr. Donnet.*) You have no doubt much experience in the dietary which is carried on board arctic ships. Have you thought of any article which might be added to or substituted in lieu of any which now form the dietary of your ships?—Yes; I think a greater variety might be made, both with regard to meat and vegetables.

655. Could you mention to the Committee what changes you would make?—I think if condensed milk were introduced into the diet it would be advantageous; backless chickens might be issued once a week or a fortnight, and I think parsnips and beet-root would be good vegetables, if the latter could be preserved. Beer and wine I also think would be preferable to spirits. That is all that I can think of at the present moment.

656. Do you think that an addition to the preserved fruits, pickles, or other preserved vegetables now furnished, would add to the health of the men?—Yes, I think so; those that I have mentioned, certainly.

657. Had you any compressed vegetables amongst the articles in your dietary?—The cabbage was, I think, compressed.

658. Have you formed any opinion upon the value of the preserved and the fresh meats relatively as articles of food, and, if possible, say in what proportion you hold the nutritious properties of each one to the other?—As to the preserved and fresh meats that we had with us, I considered them all to be very good; but I could not say which contained the greatest amount of nutriment. I consider fresh meat infinitely superior to preserved meat.

659. Were beef and mutton in their preserved state supplied to the ship, and, if so, was any preference given to the one over the other?—Beef and mutton were both supplied in tins, and I think it was quite a matter of taste regarding the preference, one liking one and another the other. I have no choice myself between the two; I would just as soon have the one as the other.

660. Did you prefer eating these preserved meats cold or warm?—I think that was also matter of taste.

661. Were the preserved soups supplied liked by the men?—Yes, the hotch-potch and the ox cheek, and the preference was given to the latter.

662. You say that you could not improve upon the dietary supplied to the sledge parties; was there no article which you might have added to or substituted for any other in the dietary?—Nothing.

663. In your letter to Sir George Nares of the 1st of July, 1876, you mention the value you attach to the mid-day tea, and that you looked forward to it as the best meal of the day, and the men worked better, and appeared to possess more staying power, after that than after breakfast, and you are strongly of opinion that it should be generally adopted by all sledging parties; after having expressed so strong an opinion, would you not recommend a larger amount of tea to be taken in these parties?—No, we had sufficient.

664. Have you considered the question of the action of alcoholic spirits upon the system in cold regions, and have you found that complete absence from them is more favourable towards endurance of bodily fatigue?—I think, when taken in moderation, as we did, after the labours of the day were over, it is a very necessary stimulant.

665. In the event of your being again entrusted with the formation of a new arctic sledge party, would you give the preference to total abstainers, or would the choice of the men in this respect be indifferent to you?—I would not give the preference to total abstainers. I had two in my party, and they both suffered very severely from scurvy. I would as soon take a man of temperate habits as a total abstainer.

666. You had, therefore, two exceptions in your party who refused their allowance of rum?—Yes.

667. Do you consider this ration of rum in sledge travelling necessary?—Yes; I should be sorry to go without it. When we left on our spring travelling, I did not touch my grog for more than a month, but I found I was better when I took to it than when I went without it.

668. Did you remark that the appetite or the vigour of the men was improved by the allowance of rum being taken?—No; I did not take special notice regarding it.

669. In the evidence afforded to the Committee, it has been stated that the men did not feel so vigorous after having taken their rum; did you observe this? No; not during the sledge travelling. It was always administered by me after the men were in their sleeping bags, and after supper was over.

670. In your diet list no lime juice is supplied; do you attach any value to this article being supplied to a sledge party?—No.

671. Have you formed any opinion about its preventive qualities from an attack of scurvy?—I do not think it is a preventive.

672. Would you not, therefore, carry lime juice in a sledge party?—No.

673. In the ships which you have commanded, or in those in which you have served, has the allowance of lime juice prescribed by the instructions been given regularly?—Yes; to the best of my belief it has.

674. For what purpose was it given?—As an antiscorbutic; as a preventive against scurvy.

675. As I imagine, none but those who have experienced it, can tell what travelling on ice such as you encountered is; could you kindly give the Committee some idea of this ice, and of the difficulty of travelling; and I will ask you what comparison, if any, can be drawn between the amount of fatigue incurred by an arctic day's work and that of any sort of work done in England?—I know of no work that I could compare it to. The diet is different, the work is different, and the climate is so different. As a rule, we worked for 11 hours a-day, exclusive of meals. The snow was always very deep, making dragging very laborious; added to which the hummocks of ice were so impenetrable that we had to cut a way through with our pickaxes; advancing only about a mile and a-half a-day; and to perform this distance we had frequently to march a distance of 10, 12, and even 15 miles. The sledges were generally advanced one at a time. The hummocks varied in height from 15 to 50 feet.

676. Was the depth of snow in any part very great?—Frequently up to our waists, and generally over our knees.

677. How did your men sleep after this fatigue?—When we first started, when the weather was very cold, very little sleep could be obtained by any of us, but afterwards, when the temperature rose, we generally slept fairly.

678. I believe that you have said that your greatest cold was 45° below zero?—Yes.

679. Had this intense cold any share in the production of the fatigue caused by those journeys?—No, I think not; it simply deprived us of rest.

680. When you were in your sleeping-bags were you able to keep your feet warm?—During the cold weather, speaking for myself, no; and the men, as a rule, complained of cold feet.

681. You mention the pallor observed in your men on the re-appearance of the sun; was this attributable to the darkness in which they had lived during the winter season?—I think it was, as it appeared in all, both officers and men.

682. Amongst the men of your party, did you find the marines as fitted for the work as the blue jackets?—I only had one in my party, and he succumbed very early.

683. Had you in your experience observed a craving for lime juice amongst the men when sledging?—No.

684. Was the lime juice which you gave them taken with a relish?—Yes.

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685. Was it taken in tea, or in what manner?—In the usual way, with water.

686. You mention that thirst was a marked symptom amongst your men; as water was scarce, did they take snow to quench it?—No, they were warned against doing so; and one or two had been laid up from eating snow during the autumn travelling, when we gained our first experience.

687. With regard to the discolouration of the legs which you mentioned Lieut. Parr suffered from, did this discolouration resemble red or black spots?—I only heard from Dr. Colan, after my return to the ship, that Lieut. Parr's legs exhibited those symptoms; I did not see them myself.

688. Do you attach any importance to butter and suet as articles of diet in a sledging party?—Yes, I think butter might be advantageous.

689. Was there much enthusiasm amongst your men?—Very much.

690. When obliged to turn back from the insurmountable obstacles which lay in your way, and when the excitement of discovery had abated, did you remark any signs of despondency amongst your men?—With one or two exceptions they all bore up nobly and cheerfully.

691. Have you given thought to the matter, and can you assign any special or general cause for the outbreak of scurvy amongst these men?—I should think that the long absence of the sun was one of the chief predisposing causes, also the dampness that we unavoidably experienced between decks, and the want of fresh animal and vegetable food.

692. Do you think that the men would have suffered had there been no sledge travelling?—Yes, but not to such an extent.

693. (*Dr. Fraser.*) I observe that you told Dr. Donnet that at one time you had voluntarily deprived yourself of all alcohol for four weeks, and that you felt better on resuming the consumption of a moderate quantity of alcohol; is that so?—Yes.

694. How did you feel better?—I felt more cheerful.

695. You did not find, did you, that your appetite was improved?—No.

696. Or that your personal vigour was improved?—No, I think not; but it tended to cheer our spirits.

697. Nor did you find that you were better able to withstand exposure to cold or to climate vicissitude?—I found no difference between the two in that respect.

698. With reference to the scale of dietary, can you inform the Committee whether any preserved eggs were carried by the expedition?—There was some egg powder, which was also brought out to us as a medical comfort by the relieving party.

699. But no preserved eggs?—None that I know of.

700. Have you any knowledge of the possibility of preserving eggs for considerable periods of time, and carrying them in such an expedition as yours was?—If a large stock could be obtained during the breeding season of the birds up there, I think they could easily be kept during the winter, but they would take up a very large space.

701. I presume you mean that the low temperature would act as a preservative?—Yes.

702. Had ordinary poultry eggs been carried to the arctic regions, they, therefore, would have been subjected to the same preservative influence as the birds' eggs that you refer to?—When I went up to the arctic regions in 1873, we were supplied with a large stock of eggs, the last of which were eaten in the month of August, about four months after leaving England, and they were perfectly good.

703. Had you retained a number of them beyond the four months, and remained for a long period of time in the arctic regions, so far as you can infer they would have remained sufficiently good for eating purposes?—Yes, I think they would, undoubtedly.

704. How were the eggs to which you refer pre-

served in the expedition of 1873?—No special precautions were taken; they were simply kept in a basket in a cool place in the ship.

705. Then, even without any special precaution, you found that they could be kept for four months?—Yes; but then we left England in cold weather, in the month of April.

706. Have you any knowledge of the preservative power of milk of lime with regard to eggs?—No personal knowledge.

707. You do not know that even in the climate of this country they may be perfectly preserved in milk of lime for twelve months at least?—No.

708. Do you now think that it might have been an advantage to have been supplied with a stock of fresh eggs?—Yes, if we could have kept them in a safe place.

709. (*Admiral Sir R. Collinson.*) I wish to ask you to compare your autumn travelling with your spring travelling: in the first place, as regards the travelling itself; and, in the second place, as to its effect on the men who composed the sledge parties?—The nature of the travelling in the autumn was totally different to that I experienced in the spring. My journey in the autumn being made along a coast line, the sledges were generally kept to the ice foot, and therefore no road-making was required. The snow in the autumn was very deep, and in that case it was similar to the spring travelling. The snow fell for 16 out of the 20 days that I was away, and the discomforts during the autumn were greater, although the temperature was higher than that experienced in the spring. The nature of the young ice, on which we occasionally ventured, was weak and rotten, and we were subjected several times to immersion. Some of the men got completely in. We were, therefore, more subject to frost-bites; but the men appeared as cheerful and as willing during the autumn as during the spring travelling.

710. Were the weights dragged similar?—The weights dragged during the autumn were considerably less than those dragged during the spring.

711. I perceive that, before you left the land, and therefore while travelling on the same ground as you were on in the autumn, scurvy had made its appearance among your crew in the spring?—The scurvy did not make its appearance until after I had passed the limit of my autumn travelling.

712. On the third day, was it not?—I think it was two days after my supporting sledges left me. I do not refer to the two cases that were sent back, as I did not know that they were scurvy; nor do I know now that those two men suffered from scurvy. The 14th of April is the first date that my party were attacked.

713. But the men had to fall out from the sledge on the third day after leaving the ship?—Yes; which we attributed entirely to the men overworking themselves. I do not think that the man Elias Hill suffered from scurvy, and I do not think he was ever treated for scurvy.

714. Will you describe to the Committee your costume generally?—We wore thick flannel underclothes, then a check shirt or two, then a stout knitted guernsey, over which we wore our duffle suits (as a rule, the duffle coat was only worn at night time), and we had a suit of duck overalls over. On our heads we generally wore a woollen helmet cap, surmounted by a stout sealskin one. On our feet we wore one or two pairs of blanket wrappers, thick wad-mill hose coming over the knees, and moccasins, which also had leggings fitted to them.

715. Was the perspiration that you experienced very great?—Yes, round the waistbands of our trousers.

716. Consequently the loins were always damp?—Yes. We all wore flannel cholera belts, which I forgot to mention amongst the articles of clothing.

717. Did the perspiration find its way through the drawers into the lining of the trousers?—Yes; the flaps of the duffle trousers were frozen so hard in con-

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sequence of the moisture, that we were unable for some days to button them.

718. Did you sleep in those trousers?—Yes; we changed nothing but our foot gear and head gear.

719. And therefore you took ice on your trousers into your blanket bags?—Yes; they were frozen.

720. Had you much moisture with your stockings or your blanket wrappers for the feet?—Yes; those which we wore during the day were, as a rule, frozen so hard in the morning that we had difficulty in bending them over our feet.

721. Where were they kept during the night?—In the very cold weather we generally kept them in our sleeping bags; the majority of us used to tie them round our knees, to keep our knees warm.

722. Was the blanket-wrapper, or the stocking, next the skin?—The blanket-wrapper invariably, though some wore a light sock next their skin.

723. And what was done with those blanket-wrappers during the night?—They were either put in the bags, or tied round the knees of the men; when the sun was powerful enough they were dried by hanging them up along the ridge rope of the tent.

724. What was done with the moccasins during the night?—The moccasins, after being taken off, were always well brushed out, and generally placed under our heads for pillows.

725. What did you put on your feet during the night?—Similar to what we wore during the day; one or two pairs of blanket-wrappers, wadmil hose, and a pair of moccasins.

726. Was there no fur attached to the sleeping moccasin?—None whatever; they were made of moose skin.

727. You have already stated that you consider that the winter passed by you was the predisposing cause of the attack of scurvy which you suffered; do you not consider that the severe labour undergone in dragging the sledge over the ice, of which you have given a description, and the depth of snow causing very great exertion on the part of the men almost every step they took, was also another cause?—I think the severe physical labour endured by the men assisted to develope the disease, but I do not regard it as a predisposing cause.

728. On first starting, did the men take their food kindly?—Yes, with one or two exceptions.

729. Were those exceptions the cases which were first attacked, or which suffered severely afterwards?—One was one of the first attacked, and who suffered very severely indeed, but all took kindly to their pemmican after the first week or thereabouts.

730. Was the three-quarters of a pound of pemmican consumed during the first week by each man?—No; in the first fortnight, when the men were on three-quarters of a pound allowance, we saved enough pemmican to give us an extra day's provisions for the party; in fact our stew-pan would not cook the whole allowance of a pound per man.

731. So that at no time the ration was consumed during the time that you were absent from the ship during the spring?—Not in my own particular party; but Lieut. Parr's sledge being provided with a larger cooking apparatus, they consumed the whole of their allowance of three-quarters of a pound.

732. You therefore do not think that the quantity of provision issued in any way contributed to the outbreak of disease?—No.

733. (*Admiral Inglefield.*) I see in your journal, on Tuesday, May 2nd: "The invalids are not improving, and we are inclined to believe that they are all attacked with scurvy, although we have not been led to suppose that there is any probability of our being so afflicted, and are ignorant of the symptoms." How is it that during the long winter months this had not been the subject of discussion, and that you were not provided with full instructions from the medical officers?—I cannot say; scurvy was not anticipated, and was not talked of.

734. And you received no instructions from the medical officers, should an outbreak occur?—None.

735. Nor were you provided indeed with remedies?—No.

736. Do you think it would have been possible to have carried lime juice in the shape of lozenges, say in the form of acidulated drops, which would have admitted of being readily dissolved either in the tea or in the mouth?—If they could be so constructed I should think that they could easily be carried, although I do not know that they would be of any use. The men on board ship, although they never went sledging, and who took their lime juice every day, had scurvy equally with those who went sledging.

737. On May 18th you state: "Our small modicum of lime juice is nearly all expended, although it has been most carefully husbanded." I do not remember whether you have put in a statement of the actual quantity carried; how much per man a day is the ration?—It was not issued as a ration, it was simply given to the sick when the scorbutic symptoms made their appearance, and we were convinced that they were scorbutic.

738. On May 20th, I see that the men used to take the tea-leaves after luncheon and supper, and devour them with avidity; was that at your suggestion, or was it their own idea?—They had heard that Sir Leopold M'Clintock had spoken of tea-leaves as a good vegetable, and for that reason they used to eat them. I did not discourage their doing so, but I did not think it would have any good effect, although it would not have a bad one.

739. Of the men who had not travelled, were any attacked with scurvy?—Yes.

740. How many, and who?—Three only, I think, did not travel, and all were attacked with scurvy. Those three men were the ship's steward, the ward-room steward, and the ship's cook.

741. Did those men take lime juice during the whole time?—I believe so, regularly.

742. What would the temperance men have to drink at night instead of rum?—Nothing; but as a rule we used to give them what they called the "blue," which is the overplus; it is the plush of the tea, which we always used to give to the temperance men.

743. Did those three men which you have named, the cook and the ship's steward and the ward-room steward take their lime juice during the whole time?—Yes, I believe they did.

744. And did they take the proper amount of exercise?—Yes, they certainly took their two hours per diem, if not more.

745. (*The Chairman.*) You have already stated that you consider the severe nature of the work contributed not to originate but to develope scurvy. If you had the same journey to undertake again would you diminish the length of the day's journey?—No, I think not.

746. Will you state the grounds for not doing so?—Because we preferred working to lying for any length of time in our cold bags.

747. Did your foot gear keep the feet dry, or were the feet of the men wet at the expiration of their day's work?—The feet, if warm, were wet from perspiration, otherwise they were cold and dry.

748. Then wet feet cannot be included amongst the causes which contributed to the outbreak of scurvy?—I do not think so.

749. Although the question has already been touched upon, I must again ask whether, assuming that you could have administered a daily allowance of lime juice to your sledge party, are you of opinion that the outbreak of scurvy would have been either averted or delayed?—I do not think it would.

750. State the grounds for your belief?—From the fact that those on board who had lime juice administered to them daily since leaving England suffered from the disease; one very seriously.

751. Can you name the man?—The ship's steward, George Burroughs.

752. Then had he been engaged in sledge travelling at all, either during the autumn or spring?—No.

753. You have described the mode in which you

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melted the lime juico. Supposing that lime juice had been supplied in bottles containing a daily allowance for each man only, do you think that each man could have melted his daily allowance in that mode?—Yes; but I do not think that we could have carried them safely.

754. Why not?—The number of bottles would be so liable to breakage, and the weight would be excessive.

755. When melted by yourself, in the way you have described, was the liquor so obtained pure lime juice or partly spirits, and in what proportion?—That I am unable to say; but I should think the greater part of it would be the spirit.

756. Can you suggest any mode in which lime juice can be carried, so as to admit of being conveniently used under the temperatures incident to your spring sledge journey?—I cannot, unless taken in the way that Admiral Inglefield has just referred to.

757. With the means at your disposal in the ship, could you have melted and used lime juice on your northern sledge journey?—No.

758. Why not?—Because there were no means, that we could have taken with us, of thawing the lime juice, or of carrying it in sufficient bulk for a daily ration.

759. (*Admiral Inglefield.*) Could not the lime juice have been carried in small bladders, which, while more or less elastic, would have been less liable to fracture and loss, and thus each man might have thawed his day's ration in the manner in which you described you occasionally thawed lime juice?—I do not know. I do not know what the action of the strong acid would be on the bladder, or whether it would crack from excessive cold.

760. Can you state what sized capsule or bladder would each man's ration have occupied?—Do you mean for the whole period of our absence?

761. No; that you might have carried it in quantities; but each man might have been supplied in the morning with his bladder of lime juice for the day, and have thawed it in the manner you did?—The daily ration would be about equal in bulk to what a small egg would contain; a bantam's egg we will say, without the sugar.

762. Then, under these circumstances, there could have been no difficulty in thawing the lime juice without the use of fuel?—No, but fuel would be required to thaw the snow for the water to mix with the lime juice.

763. But I am adverting now to the evidence which was given before the Committee yesterday, with reference to the possibility of adding the ration of lime juice to the tea which was daily made for the use of the sledging crew, and thus no extra expenditure of fuel would be necessary?—Then, if mixed with the tea, no extra amount of fuel would be required; but I should be very sorry to drink the decoction after. The weights would be much increased by a daily ration of lime juice, because the weight of sugar is actually more than the weight of lime juice.

764. Where is the necessity of mixing sugar with it; only to make it more palatable?—Yes.

765. (*Dr. Donnet.*) You have mentioned moisture as one of the causes of the production of scurvy; do you believe that the three men, the ship's steward, the ship's cook, and the ward-room cook were more exposed to this influence?—No. I think the ship's steward and the ward-room steward were more exempt from it, having cabins of their own in which they slept.

766. Do you know of any causes that could have produced scurvy in these men?—I know of none.

767. Were any of these three men intemperate in their habits?—Yes; one was before we went into winter quarters, but I think during the winter he was very abstemious; and another man was supposed to be intemperate when opportunities occurred, though never detected in any actual state of drunkenness.

768. Do you know whether these men had scurvy

in a severe form?—One had, I believe, very severely, so much so as to endanger his life.

769. Are you aware that a greater number of men were attacked by scurvy on board your ship, compared with the number on board the "Discovery," the number on board the "Discovery" being 16, whilst that of the "Alert" was 38; and, if so, were there any special reasons why one ship should have had this disease in a greater proportion?—I think, amongst the 38 attacked on board the "Alert," were very many of the "Discovery's" crew; and the amount of fresh animal food which the "Discovery" had was infinitely greater than that which we had on board the "Alert."

770. Were not these men living on board the "Alert" during the winter, and consequently exposed to the same influences as the men of the "Alert"?—No; not all. Some came up to the "Alert" from the "Discovery's" winter quarters in the spring, and were placed on the sick list for scurvy on board the "Alert." These few men did not winter on board the "Alert."

771. I find, on referring to a nosological return of Dr. Belgrave Ninnis, Staff Surgeon of Her Majesty's Ship "Discovery," that 16 cases of scurvy had occurred; 15 of these were attacked when sledging in Northern Greenland, and of this number 6, although belonging to the "Discovery," were embarked in the "Alert," in August, 1875, starting thence on the sledging journeys, and not rejoining the "Discovery" until the end of the season of 1876. Are you aware of this fact?—Yes; I am aware that 6 out of the 7 men belonging to the "Discovery," and who wintered on board the "Alert," were attacked with this disease. All of these men were not included in the sick list of the "Alert," that is to say, in the 38. Other men from the "Discovery" were placed upon our sick list for scurvy.

772. Can you give any special reason for the greater number of men attacked with scurvy on board the "Alert"?—I have no idea what the proportion of men attacked between the two ships is, taking into consideration those that wintered on board of us; but I should attribute it entirely to the greater supply of fresh meat on board the "Discovery."

773. (*Admiral Sir R. Collinson.*) Did you approve of the muck ox as fresh meat?—Very much.

774. Was that generally the case on board the ship?—Yes; and I think there was only one case in which the meat, on account of its very strong musky odour, was uneatable.

775. (*Admiral Inglefield.*) Can you inform the Committee whether it was the bull or the cow that was musky?—It was a bull that had taken a great deal of killing, and had received at least twenty bullets before death.

776. But were the cows found to be musky?—In some instances slightly, but not to render them uneatable.

777. Were the numbers of cow and bull musk oxen fairly proportionate?—In the summer of 1876, out of the 6 musk oxen that we obtained, 4 were bulls; in the autumn, out of the 12 that we obtained, the majority were cows, but they were shot in herds.

778. Were you able to discover, after some practice, whether it was possible to kill the meat, so as to avoid the musky flavour?—No, although they were invariably skinned, cleaned, and cut up the moment they were killed.

779. Can you give the Committee any positive information as to your opinion upon the question why the outbreak of scurvy was peculiarly virulent in the late expedition?—I cannot, except it be attributable to the long absence of the sun, the unavoidable dampness between decks, and the severe physical labours endured by the men, and I think also the intense cold.

780. Has it ever occurred to you that men who had been in some measure acclimatised would have been less susceptible to these influences?—No, I think not. Our ice-quartermasters, who had made

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several voyages in the arctic regions, some of whom had spent many winters out there, were as susceptible to the disease as our own men.

781. Had any of your ice-quartermasters experienced themselves an attack of scurvy?—I think not; although they occasionally spoke as if they were familiar with the disease.

782. Had they had any notions of their own, peculiar to their class, as to the means by which an attack of the disease may be combated?—I do not think so; if they had I never knew them.

783. Did they take their lime juice with the other people kindly?—Yes; every man in the ship had to drink his lime juice at the tub on the quarterdeck, in the presence of an officer.

784. (*The Chairman.*) Speaking generally; were you entirely satisfied with the equipment of the "Alert" for the special service in which she was to be engaged?—Yes, very much so.

785. I hold in my hand a pamphlet, entitled "Arctic Committee: Description of Travelling Equipments,"

in the preface of which I find: "With a view to retain, and to add to, our present knowledge of arctic travelling equipments, I request that at the close of the expedition, this manuscript, compiled by me for its use, may be returned to the Admiralty, accompanied with the remarks on each article of those officers and men who have been most employed in sledge travelling, and gathered from them after all the sledging has terminated." Signed by Sir Leopold M-Clintock, Admiral Superintendent, Portsmouth, 24th May, 1875. Has this pamphlet been referred to you for the purpose named?—Not yet; but I have my notes and everything ready to comply with that request.

786. Will you furnish the following returns to the Committee in the forms supplied to you:—

1. Meteorological return.
2. Return of sledge work.
3. A return of distance travelled.
4. A return showing the alteration of the sledge lading, if lime juice had been carried.

(Appendix
No. 15.)

The witness withdrew.

LIEUTENANT WILLIAM HENRY MAY, R.N., *examined.*

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787. (*The Chairman.*) On what day did you join the "Alert"?—

788. Did you belong to her till she was paid off?—Yes.

789. What special duty was assigned to you?—Navigating duties.

790. On what sledge journeys were you employed?—In the autumn, 20 days away to Cape Joseph Henry, laying a depôt out for the spring travelling, and five short journeys with the dogs in the spring. Two of the latter were for the relief of the party.

791. In your autumn journey, did any of the party suffer from scurvy?—No.

792. Was the dietary prescribed for your sledge party the same as that prescribed for the other parties?—Yes; in the autumn it was, but in the spring it was a little different at times.

793. In what respects did it differ on the spring journeys?—In the latter part of the spring journeys, the last three journeys I went, I had lime juice, and the last journey of all a double allowance of lime juice, and once and-a-half the ration of potatoes.

794. And in those journeys the temperature was such that the lime juice could be carried and used without inconvenience?—Yes.

795. (*Admiral Sir R. Collinson.*) Did you issue the lime juice regularly during the sledging?—Yes, when I had it with me.

796. At what time of the day was it given?—The water was made as we were pitching the tent, and it was issued as soon as the water was made.

797. How many people had you with you?—On the first spring journey I had two officers and an Esquimaux, four, all told. The second journey I had an able seaman and an Esquimaux. The next journey, six, all told. The fourth journey we were two for the greater part of the time (I started with three, and finished it with two); and the fifth journey I had four, all told.

798. Will you state the number of days you were absent from the ship on each journey?—Five days on the first, six days the second, thirteen days the third, I think six days the fourth, and seven days the fifth.

799. Were any of your party attacked with scurvy?—In the first spring journey the Esquimaux showed signs which I afterwards knew to be scurvy, but no others had it.

800. Nor on any of the subsequent journeys?—No.

801. So that no real attack of scurvy occurred to the men under your command?—No.

802. What do you attribute that immunity to?—I think it is brought out by hard work, as I think that men remaining on board the ship would have little or no scurvy.

803. You had no scurvy in yours, and I ask you to what do you attribute the immunity from scurvy of your party?—I cannot say, as these signs appeared the second day after leaving the ship.

804. Your men were not called upon to perform the same arduous duty in dragging as they were in the other parties, owing to your sledge being dragged by dogs?—Although they were not continually pulling, the men very generally had to be shoving at the back of the sledge, to keep it going; and when the sledge stopped, as the dogs do (they sit and look at you), it required a great exertion on the part of two or three men, over exertion, to haul the sledge and start it again over any hummock or rough ground, or through any deep snow.

805. Do you think that the fact of having partaken of a ration of lime juice was useful in preventing your party being attacked by scurvy?—Yes.

806. (*Admiral Inglefield.*) Did the Esquimaux take their lime juice regularly with the rest of the ship's company?—Yes, I believe so.

807. But if it was all taken on the quarterdeck, surely they would have been mustered with the men, and there could be no doubt about it?—They were so, I believe. The sub-lieutenant had the superintendence of it, and he had to see it was issued to every man every day.

808. Did you ever learn that the Esquimaux had a specific of their own against scurvy?—No.

809. Were they aware of the nature of the disease when it broke out; for instance, did the man whom you described as showing symptoms soon after you left the ship, the second day, I think, you said, recognise it as a complaint of which he was aware?—No; he never told me so.

810. Had you full medical instructions before leaving the ship as to the symptoms and proper remedies?—No, I think not, from what I can recollect of the instructions. There were very long instructions written out, but I do not think that there was anything said about the symptoms.

811. Had it not been a matter of constant conversation during the winter months: the possibility of scurvy occurring, its symptoms, and the remedies; so that you had become in some measure acquainted with the disease?—No, very little was spoken about, indeed, touching on scurvy, as we thought that we were, at all events, safe till the second winter; but we were all warned, and used to eat our fresh meat and vegetables, and as much of it as we could get.

812. But you took lime juice with the perfect understanding that it was an antiscorbutic, and with the view of keeping yourselves in better condition to avoid the outbreak?—Yes.

813. (*Dr Donnet.*) Were any of your men affected

with debility during the autumn journeys?—No, with the exception of frost-bites.

814. Were many of your men frost-bitten?—I think five out of the eight were frost-bitten, and two of them were serious cases.

815. What part of the body in these serious cases was frost-bitten?—The big toes.

816. Were they unable to continue their work?—No, they pulled just the same as usual; they did their usual work.

817. You say that you had lime juice supplied you in your last spring journeys; had you none supplied you in your autumn journeys; and why was it that lime juice was only taken during the late journeys?—We had no lime juice in the autumn; and the reason I always thought why the lime juice was not taken in the early part was because of the low temperature and the extra weight on the sledges.

818. Do you think that this low temperature would have affected the quality of the lime juice?—I think so.

819. Have you any experience or reason for thinking that the lime juice would be affected by a low temperature?—No.

820. Did the men on the spring journeys like the lime juice?—Very much.

821. Did you observe among them a craving for it, and did they take it with pleasure?—There was no craving, but they took it with great pleasure after working for four, five, or six hours without anything to drink.

822. Did your men suffer from thirst?—Yes.

823. Was it to quench this thirst that they took the lime juice?—No; I think they would have taken it anyway.

824. What proportion of lime juice for each man daily did you take in your sledge?—I think it was 2 oz. per man.

825. Were you able to serve it out readily?—Yes.

826. I mean, it was not frozen?—No, because there the temperature was above zero.

827. You say the Esquimaux was the only case of scurvy in your sledge expedition; did this man refuse his lime juice, or was there any peculiarity about him?—When he was sledging with me, we had no ration of lime juice. He had no other peculiarity, except eating very little.

828. Did his case prove a severe one?—No.

829. Have you formed any opinion about the value of lime juice as a preventive to scurvy in arctic journeys?—I do not think it would have kept it away from the long sledging parties.

830. (*The Chairman.*) Will you furnish the following returns to the Committee in the forms supplied to you: a meteorological return, and a return showing the distance travelled and made good?—Yes.

831. (*Dr. Donnet.*) Were you not the subject of frost-bite?—Yes.

832. Where were you frost-bitten, and with what severity?—I was frost-bitten in both my big toes. In the case of the right toe, the flesh just sloughed off and grew again, and the left toe was cut off just below the first joint.

833. (*Admiral Sir R. Collinson.*) Was that occasioned by travelling through floods and getting wet?—Yes. The night that I was frost-bitten I was going upon the ice to see if it would bear sledging, and went through.

834. (*The Chairman.*) Were you entirely satisfied with the equipment of the "Alert" for the special service in which she was employed?—I was, certainly, when we started.

835. Then, subsequently, did you see reason to change your opinion?—Yes.

836. State why?—I believe that the medical comforts, such as condensed milk and egg powder, have a great tendency to keep away scurvy, as one man, James Self, who did all spring sledging with me, and did upwards of 90 days, was for the whole winter laid up without taking any exercise whatever; and the last journey that I went with him he was one of the strongest men we have had, which I can only attribute to his having medical comforts during the time he was laid up with frost-bite.

837. And therefore you would consider that a supply sufficient for general use of the two articles which you have named would have been expedient?—I think it would have been a very great advantage.

838. Have you any further suggestion to make?—No.

839. (*Dr. Donnet.*) I would like to ask your opinion upon the value of spirits in an arctic sledge journey?—I think that it is of great use to men after they have had their supper to have a small amount of spirits.

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The witness withdrew.

Adjourned to Monday next at 11 o'clock.

MONDAY, 15TH JANUARY, 1877.

PRESENT:

ADMIRAL SIR JAMES HOPE, G.C.B., in the Chair.

ADMIRAL SIR R. COLLINSON, K.C.B.

VICE-ADMIRAL, E. A. INGLEFIELD, C.B., F.R.S.

JAMES J. L. DONNET, ESQ., M.D., Inspector-General of Hospitals and Fleets, R.N.

H. J. VANSITTART NEALE, ESQ., Secretary.

COMMANDER LEWIS ANTHONY BEAUMONT, R.N., *examined.*

840. (*The Chairman.*) On what day did you join the "Discovery"?—The day of her commission, the 15th of April.

841. And you remained in her till she was paid off?—Yes.

842. Enumerate the sledge journeys on which you were employed?—The North Greenland expedition. There was one in the autumn, but that was a cart journey which only lasted for one night.

843. (*Admiral Sir R. Collinson.*) Therefore, you had no experience in autumn travelling at all?—No.

844. In the spring, what time did you leave the ship?—The 6th of April.

845. And you went from the "Discovery" up to the "Alert"?—Yes.

846. What was your equipment; what were you dragging per man between the "Discovery" and the "Alert"?—The equipment was the full equipment. I do not think I could go through it from memory.

847. Could you give the Committee an idea of the weights that you carried?—About 150 lbs. per man, I think.

Comr. L. A. Beaumont, R.N.

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Comr. L.
A. Beaumont,
R.N.
15 Jan., 1877.

848. Did your men show any signs of weakness between the "Discovery" and the "Alert"?—The first three days, probably on account of the unusual exertion, they did; but they recovered quite after that.

849. Were all the men that went with you to the "Alert" able to go on with you across Robeson's Strait to Greenland?—Yes.

850. What rest had they on board the "Alert"?—From Sunday at 10 a.m. to Thursday the 20th April, at 7 p.m.

851. Was this beneficial to them?—I should think so.

852. Was the ice more difficult for travelling between the "Alert" and the Greenland shore, or between the "Discovery" and the "Alert"?—On the whole there was a greater amount of rough travelling between the "Discovery" and the "Alert" in consequence of following the shore; and from the "Alert" to Greenland, there were several very large floes which saved a great deal of the labour.

853. In that transit, was there much of last year's ice, or was it all hummocky?—I do not think I am sufficiently experienced to tell what last year's ice exactly is.

854. Was it perfectly level, as it would be if it was last year's ice?—No; there was no level ice at all. There were several large floes which were free from hummocks.

855. So that there were no open pools of water?—None whatever.

856. I mean that the ice, when it comes together in the winter, sometimes leaves a pool which is frozen over, and would give you an expanse of half a mile of perfectly level ice, which would not be broken up until the ensuing spring. Did you come to any ice of that description, or was it all hummocky old ice?—Towards the Greenland shore we passed over several very smooth floes which appeared to be comparatively new ice, and which did give us good travelling, but it was not very large in extent.

857. In going along the north coast of Greenland, what was the character of the ice that you met with? Very heavy and broken up.

858. Was there no smooth ice between the hummocks and the shore?—None whatever.

859. Consequently the shore would be steep to?—During the first half of the journey it was, but the latter half, although the land was low, it was fringed with very large floe-bergs which prevented the ice foot.

860. What was the character of the ice foot?—There was no ice foot, such as I understand it.

861. Did you find an ice foot between the "Discovery" and the "Alert"?—For a considerable part of the way.

862. That was in consequence of the formation of the shore?—Yes.

863. You find no ice foot where the land is sloping and low?—We had some ice foot under these conditions. If the heavy ice aground is some distance off the shore, it generally leaves a smooth walk inside, or sometimes outside the barrier, if the barrier is close to the shore; and that was the case going to the "Alert," sometimes inside and sometimes outside, but on the Greenland coast there was none.

864. The ice foot is entirely occasioned by the rise and fall of the tide, is it not?—I believe it is, and is broken up at every spring tide generally.

865. Did you observe the ice crack along the shore, on any occasion, in consequence of the tide?—In our own harbour, and on the way to the "Alert," we did.

866. Had you any tidal observations on the Greenland side?—No.

867. Should you think that the tide did not rise and fall so high on the Greenland side in consequence of the ice foot being not so remarkable on that side as it is on the other?—I have mentioned in my report, that from that and other observations, I was under the impression that the effect of the tide was not so strong on the Greenland shore.

868. Did you ever take to the land in preference to

the sea for sledge travelling?—After reaching the Greenland coast we kept to the land nearly the whole time, as long as we could.

869. Was the dragging of the sledge more difficult on the land snow than on the sea snow?—We went on to the sea snow because we had to pass some perpendicular cliffs, and it happened that there the ice was not so bad as it appeared to be everywhere else, but I do not think we could have made so much progress on the floes as we did on the land.

870. The confused condition of the packed ice rendered the travelling over the pack more difficult than the travelling on the shore; that is, it involved harder labour?—From the experience which we had, travelling on shore was harder work, but quicker.

871. You had no roads to make on the shore, had you?—Yes; wherever a hill was so steep that it was impossible to stand on it.

872. When you speak of a hill, do you mean the side of a drift, or of a hill itself?—In many places it was the talus of the hill itself.

873. Denuded of snow?—No.

874. About what period did your first sickness occur?—It first came to my notice on the 6th of May.

875. And you found that Hand, which was the man's name, was so ill that you deemed it necessary to send him back with Lieutenant Rawson; on what day was that?—I came to the decision that he should return, on the 9th of May. We were night travelling, therefore it was very late on the 9th; it was half-past eleven at night, almost the 10th.

876. Had you then ascertained that it was scurvy which he was suffering from?—I was convinced of it, both from my own knowledge and from the opinion of Alexander Gray, an old whaler, the captain of my sledge.

877. When did the next case occur?—I became certain of the fact of scurvy in the next man not until the 21st or 22nd, I am not quite sure which, though stiffness had been prevalent for some time amongst two.

878. At your farthest point reached, how many men were incapable of dragging the sledge?—At the actually farthest point when reached we were all dragging.

879. About what date did the men fall out from the drag-rope?—On the 23rd, two men were no longer dragging, they were able to walk but not to drag.

880. And at what period had you to put any man on the sledge?—Late on June 3rd; I am speaking from memory. In speaking about the travelling, I ought to say that from Cape Bryant, which you will see on the chart, the rest of the journey was done on the floe, for the land did not suit. We had to cross from point to point.

881. I perceive that you went from headland to headland?—Yes, and that floe was comparatively smooth, but very deep in snow, which eventually stopped our further advance.

882. I see on your return, after picking up the "Repulse" depot, you crossed the land to Newman Bay?—Yes.

883. How came you to take that course?—By the advice of Captain Nares. We thought there would probably be a good road before I left the "Alert," confirmed by a report of Lieutenant May, who left a record for me at Repulse Harbour.

884. Then it was by that record that you adopted the route through Newman Bay, and across the land to Thank-God Harbour?—That part was always intended, but it was thought possible that at that late period of the year we should not be able to round Cape Brevoort, and therefore had to find some way overland.

885. What was the general height of the land between Newman Bay and Thank-God Harbour?—We crossed the plain, and the highest point that we reached on the plain cannot have been over 200 ft., I should think.

886. Was that difficult travelling?—To us, un-

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assisted, it would have been almost impossible; but the dogs were with us then.

887. Where did Lieutenant Rawson meet you?—He met me at the spit that you see running out from the peninsula into Newman Bay, on the 25th, about four miles to the north of that spit.

888. Had you, previously to meeting him, obtained any fresh food?—I shot one small ptarmigan on the 9th of June, I think, which was given to the sick; that was all.

889. On your arrival at Thank-God Harbour what was the condition of your sledge crew generally?—I should perhaps say, that upon arrival at Repulse Harbour the condition of the crew was thus: William Jenkins (carpenter's mate), and Charles Paul (A.B.), quite helpless and carried; Peter Craig able to walk, but very slowly; Wilson Dobing, very lame and unable to exert his full strength; Frank Jones, stiff from scurvy; Alexander Gray and myself, apparently quite well. Upon arrival at Thank-God Harbour the condition was: four quite helpless and carried, and three able to walk.

890. Upon your arrival at Thank-God Harbour you were able to change your diet?—Yes.

891. Will you inform the Committee what that change was?—We got preserved meat instead of pemmican, and we got seal meat and lime juice in addition.

892. Did you carry any lime juice with you at all?—From the time of starting from the "Discovery" to the arrival at Polaris Bay, No.

893. What lime juice was it that you got in Thank-God Harbour?—Lime juice left by the "Polaris" expedition.

894. Was it good?—When I tasted it it was good.

895. Was it thawed then?—Yes.

896. You drew it from the cask?—Yes.

897. Did you take it yourself?—Yes.

898. Was it beneficial to you, in your opinion?—I am unable to attribute the benefit to that alone, for there was seal meat and geese, and a proportion of fresh meat besides, and a total change of the diet from pemmican.

899. Was the effect of this change of diet very marked with your crew; did they begin to improve rapidly?—From our first arrival at Thank-God Harbour they improved rapidly, first in their mental condition, and afterwards in their bodily health; previously they had been much depressed, and the fact of arriving revived not only their spirits but their appetite, which had been next to nothing.

900. Then you ascribe their improvement to the rest, change of diet, and lime juice?—Certainly to rest and change of diet, and of course we had all been told that lime juice had a beneficial effect.

901. How long after you had arrived at Thank-God Harbour was it before Dr. Coppinger joined you?—Dr. Coppinger came and met us with Lieutenant Rawson (he was there at the time), and brought lime juice and two or three tins of preserved meat.

902. Comparing pemmican with preserved meat, which do you prefer?—As a matter of taste, preserved meat; but it is not sufficient in travelling, in my opinion.

903. Do you think that a larger proportion of preserved meat would have as good an effect as a smaller quantity of pemmican?—It is my opinion that it would take a large quantity of preserved meat to be equivalent to a sledge ration of pemmican.

904. What accommodation had you at Thank-God Harbour. Was there anything besides your tents?—There was a small observatory left by the "Polaris" expedition, but it was full of perishable stores, such as biscuit, and we did not use it as a habitation.

905. You continued to live in your tents?—Yes.

906. You sent across to the "Discovery"?—Yes.

907. Who was the officer who went?—Lieutenant Fulford.

908. And Captain Stephenson came over to you?—Yes.

909. What took place after Captain Stephenson's arrival?—He arrived on the 19th and left on the 29th of July with his men, changing two for two of our sick men who were most recovered, Frank Jones and William Jenkins.

910. The remainder of your crew were then not sufficiently recovered to go back to the ship?—Two only were not sufficiently recovered, Peter Craig and Wilson Dobing.

911. And you were left in charge of them, with whom?—With Dr. Coppinger.

912. And how many men?—Nine in all, two officers and seven men.

913. Including the sick?—Yes, including the sick.

914. When did Lieutenant Rawson leave you from Thank-God Harbour to return to the ship?—Lieutenant Rawson left with the captain's party.

915. On what date did you leave Thank-God Harbour to cross Hall Basin?—On the 8th of August, at 10 p.m.

916. What was the condition of the ice then?—From my observation, I believed that the ice of the basin had been blown out of it by the recent heavy gale, and the ice from the north, which is heavier, was then travelling south through the basin.

917. You could not have crossed without the assistance of the boat?—No.

918. When did you come to the water in which you launched the boat?—We launched the boat from the shore, and pulled for two miles to reach the ice.

919. Could you give a connected narrative of the transit from one shore to the other?—It was very difficult for me to decide whether to take the 20-foot ice boat, which weighed about 700 lbs., but was large and commodious, and would have enabled us to have crossed large expanses of water with safety, or to take the 15-foot ice boat, which of course, being very much smaller, made it difficult for nine men and all the gear to traverse with safety any large quantity of water; but, as there appeared to be so much ice, I decided upon taking the 15-foot ice boat, as the 20-foot boat would have been too heavy for dragging; and, to relieve it of weight, we rigged the sledge as a raft, and loaded it with 200 lbs. of the total weight. We started from Polaris Bay at 10 p.m. on the 8th, and then we were so loaded that I do not think the boat was more than three or four inches out of the water, and the sledge so heavy that our progress was very slow. There were nine men altogether, and eight days' provisions. We first pulled towards Cape Lupton; and, as there was a southerly drift, the ice was then travelling to the southward, and entering the ice there, about two miles from the shore, we tried to steer for St. Patrick's Bay. After passing through a great deal of loose brash ice between the heavy floes, we emerged into a large expanse of open water, and it was there that there was so much lop from the late breeze, that I was very much afraid that the water would have swamped the boat; but we crossed the three miles of water in safety, and reached the floe beyond. There we had to unload the boat, to haul her up, place the boat on the sledge, and load her again. Then we started across the floe, and went on like that for the rest of the march, unloading whenever it was necessary to embark, and unloading again whenever it was necessary to disembark, which occupied considerable time. We camped at night, after having made, I should think, 10 miles in the right direction, but evidently drifting the whole time to the south. After camping, I found the floe that we were on was in motion, which made me feel that it was necessary to keep a look-out, and perhaps to start earlier than we should otherwise have done; and I was right; for we were drifting so fast that I found it would be necessary to go on, seven hours after we had camped. It was still my intention to proceed towards St. Patrick's Bay, for that was the nearest point; but we worked all that day, and did not recover the ground we had lost. The work was very severe, for the floes were small, and were very high, and the broken ice between them was so close that

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sometimes the boat, even though heavy as she was, would hardly reach the water, and it was very difficult to push her through it with the sledge following behind. After 14 hours that day we camped again, and during the night we did not drift so much as we did during the rest before, because there was no wind, but the next morning we were so far south that I became convinced that it was necessary to make a forced march to get out of the influence of this southerly drift. Dr. Coppinger and myself both agreed that the best way would be to steer straight for Cape Baird, for we had then got so far south that we were really nearer Cape Baird than any other point. So we started that morning and worked all day, striving to reach Cape Baird, but hardly making any progress until a westerly wind sprang up and blew the ice away from the land, about Cape Lieber, opening large spaces of water, which allowed the ice so much freedom, that it all became in motion, and we were rapidly going to the south. But later on, I think, about 6 o'clock a.m. on the 12th, the wind shifted to the south-east, and blew the ice back again. After working on till 7 the next day, 35 hours, we were enabled to reach the land between Cape Baird and Cape Lieber.

920. This was a very arduous duty, was it not, to all of those who were engaged on it?—Yes.

921. What was the effect upon your sledge crew; did it reproduce symptoms of scurvy?—The two convalescents, Dobing and Craig, were spared as much as it was possible, but, nevertheless, the exertion was so severe that they were quite exhausted, and their legs were swelled; but beyond that, I do not think it did any serious harm.

922. What was your diet during those five days; was there any fresh food in it?—Preserved meat for the two convalescents, and American pemmican for the rest.

923. No fresh food?—None.

924. Any lime juice?—No. We expected to reach the ship in two or three days; we did not expect to be more than three days out in crossing.

925. (*Admiral Inglefield.*) How many sledge journeys did you make?—Only the one from the 6th of April to the 15th of August.

926. Had you instructions from the medical officer of your ship as to the symptoms of scurvy, or remedies?—No. I had medical instructions, but no mention of scurvy in them.

927. Then you were neither prepared by a knowledge of the symptoms, nor of the steps to take to abate them?—Yes; I think I knew what were the symptoms, and I always had been told that rest, fresh food, and lime juice, if obtainable, were the remedies.

928. But this information was not supplied to you in an official form by the medical officers on starting?—It was not in the written instructions.

929. To what do you attribute the long period of immunity, of yourself and the man Gray, whilst the others were all attacked?—We, neither of us, remained free from it the whole time, we got it at last.

930. I mean, were you total abstainers, or were you men of stronger constitution, or what?—I attribute it, in Gray's case, to being a man of experience in arctic life, and a strong healthy bodily frame, and in my case, in a measure, to the care I had taken during the winter, and to the fact of the responsibility of my position.

931. If you were required to undertake another sledge journey, with that experience, would you not prefer, had you the opportunity, to select men entirely from a whaling crew, or those who had been in some measure inured to arctic service?—I do not think I have sufficient experience of whaling men to say that; I think Gray was quite an exception.

932. What would have been your probable fate had you not met Lieutenant Rawson and Dr. Coppinger on June the 24th, only two of you then being able to drag the sledge, with, I think, five invalids?—There were three on the drag rope actually, but the men were hardly able to pull. If the Committee will allow

me, I will tell you what it was my intention to do. According to my calculations, the only means I had of knowing the route being the chart that was given us, I considered that I was then about 12 miles off Thank-God Harbour. It was, therefore, my intention, the last time we started, to reach the spit, pitch the tent, and leave the sick in charge of Gray and Jones, who were still able to do what was necessary for them; myself work across to Thank-God Harbour, and see if it was possible to obtain assistance. If assistance could be obtained, they would have gone back and have helped the sick in, but if there had been no assistance it was my intention to come back to the tent, to send Gray and Jones, who would have been able to have reached it in time, to the depôt, and to have remained with the sick myself.

933. Would your provisions have lasted for that period?—At the rate at which they were eating, I calculated that the provisions would have lasted 12 days longer.

934. When Paul died, he had the benefit of Dr. Coppinger's attendance; what measures were taken for his relief, and did the sick man benefit by them?—From the time that Dr. Coppinger reached us, the sick were under his care, and he used the provisions he had brought, and those that we had, according to his judgment.

935. You state in your journal that you found great benefit from the use of seal meat and game; had you had a constant supply of this, do you consider that your case would have been less unfortunate?—I am not able to do more than give an opinion, because there was no experience, but I believe that we should have been very much better.

936. On your extended journey, if you had been able to kill musk oxen and game, as was the case in some of the former arctic expeditions, your sufferings would have been less, and the men would have held out better?—That is certainly my opinion.

937. What quantity of lime juice did you carry with you, and how was it served out?—We had no lime juice on starting from the "Alert"; the lime juice was brought by Dr. Coppinger, and we took it from the 25th of June to the time we left for the "Discovery" on the 8th of August.

938. What medical comforts and medicines did you take with you?—I do not think I could give you a list.

939. I mean generally, lime juice clearly was not one of them?—That was not one of them.

940. Then you had medical comforts, and medicines for ordinary attacks of diarrhoea and such like?—Yes, we had a box of medicines containing medicines for diarrhoea and for constipation, pills, and simple dressings, and castor oil, &c.

941. Had a doctor been with your party, do you think you would have received much advantage from his assistance, being yourselves unacquainted with the symptoms and remedies for scurvy?—From what I have heard since, I think that I knew them sufficiently, both the symptoms and the remedies, and that there was nothing more to be done.

942. Did you recognise immediately the scurvy when the first symptoms broke out?—The first symptom is stiffness, and that we had been led to expect from other causes; but when the discolouration, the black and blue discoloured patches, came out, I was convinced it was scurvy.

943. I see you adopted the plan of pitching the tent over the sledge, and found great benefit; had this been done by other sledgers, or was it your own idea?—It was my own idea.

944. Where was the special advantage?—To prevent the gear on the sledge being wet by the falling thawing snow, and it formed a comfortable shelter for the sick. For about a fortnight constant snow fell, and the snow melted as it fell, and everything was wet through, except the things which we particularly took pains not to get wet, such as bedding; and if we had not adopted some plan of protecting the sledge when resting for lunch, for two hours

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generally, the bedding itself would have got wet, and to prevent this we pitched the tent over the sledge; and, keeping the sledge quite on one side, there was sufficient room for all the men that were well to sit alongside on a sail, or some dry cover, while the sick themselves were in the sledge comfortable.

945. How was the lime juice stowed in Thank-God Bay?—In the open air, in two wooden casks, when I arrived.

946. They had been visited before, had they not?—Yes.

947. I think you have not given the Committee any information of your lowest temperature on this sledge journey; can you afford us that information now?—The lowest temperature recorded was the night after we started, and it was then -45° .

948. Had you sails and kites provided for your sledges?—Sails only.

949. Were you ever able to use them?—We used our sails twice, and once with very good effect.

950. Can you tell the Committee when they were used?—On the way from the "Discovery" to the "Alert" we had a strong breeze from the south, and made sail to it, and went for about four miles across a very old floe at a great pace, running by the sledge. There was also another occasion, when Lieutenant Rawson and myself endeavoured to advance the last two sick men towards Thank-God Harbour, after having been left by Dr. Coppinger; we made use of a sail that day with benefit.

951. Can you suggest any alterations in the equipment of a sledge, or a better form of cooking apparatus?—To do the work which I found I had to do towards the end, that is, travel in very deep snow, a better form of sledge could have been used; but as for the cooking apparatus, I think that was very good.

952. And how would you describe this better form of sledge?—I thought at the time a longer and lighter sledge, capable of having the portion between the runners filled up, that is to say, made smooth between the runners so as not to sink in the snow, would be an improvement.

953. Broader runners, in fact?—More than broader runners, almost entirely covered in (not filled up) with either metal or hide, stretched between the runners to prevent sinking, and the men on snow shoes.

954. Was then the expedition not provided with snow shoes?—No, we had no snow shoes for the parties, except Lieutenant Rawson's private snow shoes, which he took back on his return.

955. Was there any difference between the American and the English pemmican?—The sweet pemmican of the Americans, which we used, was very coarse, made up of not such fine meat or so much of it, but a greater proportion of fatty substance and currants.

956. Can you give the Committee any information on the subject of the present inquiry, which your experience has suggested, with regard to the outbreak of scurvy?—In my opinion there is not a sufficient variety in the diet, but beyond that I do not think I could make any suggestion.

957. How would you suggest that it could be varied?—If it was possible to carry a greater quantity of vegetables in some compact form, I think that would be the best way. By vegetables I mean not only potatoes, but green peas and succulent vegetables of that description.

958. (Dr. Donnett.) Were the men forming your party in good health and spirits at the time of starting, and was this their first experience in sledge travelling?—Apparently, they were in very good health. They were the same men who had been out with me one night in the autumn; that was all the travelling that they had ever had.

959. With regard to the choice of men for any future arctic service, with the exception of ice quartermasters, would you prefer taking fresh and good men who had never seen arctic service?—If the men were passed as sound by the medical officers, I

should prefer to have men experienced in arctic travelling.

960. When the men forming your party had become acquainted with the difficulties of sledge travelling, did they show any decrease of their good spirits?—No.

961. Did the men readily adapt themselves to the food supplied by the sledge dietary, or did you remark any failing of appetite after their starting, and was this owing to the change in the diet, or was it due to the fatigue and the nature of the travelling?—At first starting, with some there was a natural dislike of the pemmican; with others there was a want of appetite from fatigue, but in time both were got over.

962. In travelling from headland to headland, you mentioned the great depth of snow which you encountered; would you describe the nature and the consistency of this snow?—The snow at first was fine and soft, and at that time it was about a foot deep. Gradually, as it deepened, it became caked at the top, and fine immediately under the cake, but getting coarser and coarser until you came to the floe itself. At the last place that we reached, where it varied from four to four and a half feet in thickness, there was a strong cake on the surface, about two inches thick, which was not strong enough to bear you, but allowed you to fall through, and then you were encased, as it were, in the snow, and unable to get out without pulling your legs straight out of the same hole; and the snow at the bottom close to the floe was in the form of crystals bigger than peas, giving me the impression that it was very old.

963. With what spirit did your men meet these difficulties?—The men who were feeling the effect of this very hard work met them with a stubborn determination to overcome all difficulties, and the sound ones were cheering them up.

964. Do you think that the stubbornness and enthusiasm which those men exhibited, and the determination to overcome all difficulties, tended towards decreasing their physical powers?—No, rather the contrary.

965. The temperature you mentioned was -45° on starting; did this low temperature affect in any way the health of your men?—I do not think I can judge of that, for they were indisposed from other causes; from the novelty of sleeping out in that temperature, and the hard work at the time, and their want of appetite from fatigue. The appetite was not hearty for the first two or three days, and that was the time when we experienced this very severe temperature; therefore I cannot put it down to one thing alone.

966. Could you say that the cold which they experienced had any influence in producing the depression you mentioned to have occurred afterwards?—No; because at that time the temperature had risen sufficiently to be comparatively comfortable. They could sit out for luncheon. I mean that, in the early part of the travelling, you cannot sit at luncheon, you are obliged to keep walking about; but at the time when this depression occurred, and when they were really depressed in spirits from illness, the temperature was comparatively warm.

967. How many hours of exercise did the men take during the day?—Our marches on the average were eight and a half hours a day, that is, the actual marching time.

968. Were the men quiet when encamped, or were they obliged to take extra exercise to keep themselves warm?—Never, after leaving the "Alert." Up to the time that we reached the "Alert," they were sometimes obliged to get up and move about to keep themselves warm; but after leaving the "Alert" that never was necessary, and I do not remember its ever occurring in the middle of a rest at any time.

969. Did you travel by night or by day?—Up to the time that we reached the "Alert," by day; afterwards, by night, until we were reduced to three men to drag the sledge, and then we occasionally broke through the rule from the force of circumstances.

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970. Had the men sufficient sleep, and did it prove refreshing to them?—That is a difficult question to answer.

971. Did the men complain of loss of sleep?—They complained of great fatigue, after having passed the snow slopes, which you will see on the chart. After passing Cape Staunton they complained of fatigue, and both Lieutenant Rawson and myself agreed, from our experience, as we had been dragging all the time, that the work had been so severe that, in our judgment, a day's rest was necessary, and we gave it them.

972. Did the men suffer much from thirst during your journey?—The first two days or so they did, but not after, and not then much.

973. Did any attempt to eat snow to quench their thirst, and if so, did any bad effects follow?—I warned them against it, and I do not think any did it to any great degree; at all events no bad consequences ever followed from it.

974. From your evidence I gather that you have made yourself acquainted with the symptoms of scurvy; did you recognise the symptoms which attacked your party as those of scurvy, and will you inform the Committee of the other symptoms besides stiffness and discoloration which you observed?—Inflamed and bleeding gums, loss of appetite, distaste for food, and general debility. These were the premonitory symptoms.

975. What other symptoms did you observe?—At the later stages of the disease there was the soft, puttyish nature of the flesh, which I knew to be one of the symptoms, and the bad-smelling hot breath.

976. Was this breath very offensive?—When the sun was out and the tent hot, it was very offensive.

977. Did you remark much shortness of breath amongst them?—Very much; it was a marked characteristic of the later stage of the disease, but at that time I did not know that it was a confirmation of scurvy.

978. Did any suffer from bleeding of the nose at the time?—I do not remember.

979. Were you able to give these men any assistance?—When the stiffness first began, not knowing that it was scurvy, I recommended liniment, but no good effect followed its use, and it was discontinued. Later on, when the pain was very great, I fomented their legs on camping, which gave them a good night's rest, but causing greater stiffness the next march, that was also discontinued. After that I had no more remedies to try, except to ease them of every labour.

980. Did you remark much depression of mind amongst the sick?—As each man felt that he had scurvy, he was depressed at the time, but gradually they made up their minds, as it were, to the evil, and did their very best to prevent depression of spirits.

981. You say that Hand was the first case of failure of health; was there anything particularly in the constitution of this man?—Not that I know of.

982. Was this man one of the "Alert's" crew, and did not his strength commence to fail sixteen days after you left that ship?—Hand was one of the "Discovery's" men who had passed the winter on board the "Alert," and it was about sixteen days after leaving the ship that his strength commenced to fail.

983. In the former part of your evidence you say "Alexander Gray and myself were apparently well." Why did you use the word "apparently"; had you any reason for thinking that the disease may have had existence in the system without showing itself outwardly or without your feeling any bad effects?—I think I used the word "apparently" there because it was at a time when Gray must have been affected but did not show it; but, at the same time, I also think that I left the ship myself in perfect health, and yet, as I had a slight attack of scurvy, it would seem that either I must have had the seeds of it before leaving the ship, or that I contracted the illness entirely whilst sledging.

984. Do you think that the long absence of the sun had any effect in producing scurvy in your own person?

—I cannot answer that question, except to say that it produced no depression of spirits. I do not know whether it had any bad effect or otherwise.

985. What was your diet during the winter months in addition to the ship's rations?—We had a mess stock which enabled us to have a slight variety, such as preserved and potted game, and occasionally fresh vegetables; and I attribute great benefit to the use of those vegetables.

986. I believe that you exercised yourself on the drag rope; do you think that the fatigue caused thereby had any influence in producing those symptoms?—Most undoubtedly.

987. Was the work very hard?—Very hard indeed.

988. Would you describe the symptoms which you observed in your own person?—Feeling the responsibility of my position, and the difficulty that it would leave the party in were I to succumb entirely to it, I used to examine myself regularly every camping time, and before we started in the morning; and the first thing that I noticed were very small purple spots on my legs; then the next thing was a soreness of the gums, and, lastly, stiffness in the legs. It was not until after rest at Polaris Bay that discolouration began, but it never became great, and it all gradually passed off with the rest and change of food.

989. Were you much depressed, and did the responsibility of your position add to this depression?—I was naturally anxious, but I do not think I was depressed. However, Lieutenant Rawson and Dr. Coppinger might tell you; I am hardly able to do that myself.

990. I understood you to say that on your arrival at Thauk-God Harbour you found lime juice, and that you served it out to the men; did those men take it with any greediness?—Yes; and the reason no doubt was, that they had long been accustomed to connect lime juice with the cure of scurvy, and they were very anxious to derive an immediate benefit and to ease their pain; but they were rather disappointed at its not being so rapid as they expected. That eagerness for lime juice was more the first feeling before it had actually been tried.

991. Did you remark any craving for lime juice in those men?—Such as I have just described.

992. Had you a ration of spirits in your sledge party?—Yes.

993. Did the men consider it a necessary article on a sledging expedition?—I can only answer that by the fact that they did not care very much about drinking it by itself, but when we took to putting it in the tea they did not refuse it; they liked it then.

994. Did you give them a ration of tea at luncheon?—Yes.

995. And did the men work better after taking tea than before?—Yes.

996. (*The Chairman.*) We have had it in evidence from Captain Markham, that his sledging party very frequently were up to their middle in snow, and almost constantly up to their knees. Had you much work of the same character?—No; I do not think that I had the same as is meant by Captain Markham, for that probably was caused by drifts between the hummocks. Ours was the actual thickness of the snow on a level floe, and it was never up to our waist. One is very apt to say that it is up to your waist, when it is up over your knees, because the feeling is that you are embedded in it; but I was careful not to exaggerate, and therefore I measured it, and it actually reached about three inches over our knees, and then it was impossible to push through it on account of the crust. Though I have said that the thickness was $4\frac{1}{2}$ feet, we do not sink right to the bottom; the snow gets compact, and you really stand some distance above the bottom, so that that accounts, if the snow is $4\frac{1}{2}$ feet in thickness, for your not sinking in it more than three inches above the knee; but from its consistency it is impossible to push through it; it is one continual climb in and out.

997. Would snow shoes have been of use to you always, or only occasionally, and, if the latter,

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describe on what occasions?—They would only have been of use occasionally, although, as it turned out in our expedition, at the most important part of the journey, and that was at the end, where this great depth of snow made the travelling so slow, that for the last five days we could only have advanced at the rate of about a mile a day. I can only speak of snow shoes from the opinion that I formed at the time, for they have been considered superfluous generally, and the men are said not to be able to drag a heavy weight with snow shoes; but anything would have been better than having to break through and make a road for the sledge with your legs.

998. What description of snow shoes do you recommend?—From the description of the snow shoes used by the whalers, made by themselves, I believe that would be the best, as they use them for dragging weights; long snow shoes could not be used, as the men could tread upon each other.

999. On camping at the conclusion of your journeys, were the men's feet generally wet or dry?—They remained dry up to about the 15th of May, at which time the temperature had so much risen that the heat of the body kept them quite damp, and from that time afterwards they always remained wet.

1000. Assuming that you could have administered a daily allowance of lime juice to your sledge party, are you of opinion that the outbreak of scurvy would have been either averted or delayed?—I have had no experience how far lime juice is a preventive of scurvy, because I have always seen it used with other things. At Thank-God Harbour we used lime juice and fresh meat for the recovery of the men, and on board the ship they did the same.

1001. Can you suggest any mode in which lime juice could be carried and used conveniently in the very low temperatures you experienced?—No, I have not been able to think of any way. I think that the lime juice that was at Polaris Bay (which might help a little in the investigation) was frozen when the parties first arrived there, and Lieutenant Rawson has told me that the lumps of lime juice first broken up hardly contained even the taste of lime juice, and it was not until a general thaw took place, and the whole became liquid, that they really got strong lime juice from the cask.

1002. (*Admiral Inglefield.*) Are you aware that Captain Markham was able to thaw lime juice by taking it into his bed with him?—No; I was not aware of the method in which it had been done.

1003. (*Admiral Sir R. Collinson.*) From what you know of the two vessels, which ship had the best accommodation for the men that passed the winter on board her?—The "Alert," in my opinion.

1004. The "Alert" with seven men of the "Discovery" had better accommodation than the "Discovery's" men with seven less?—Yes.

1005. Will you describe what means were taken for ventilating your lower deck on board the "Discovery"?—An uptake over the fore hatchway, and an uptake over the galley; but no special means of admitting fresh air beyond that which came through the doors on their being opened for traffic.

1006. Was there much condensation on the lower part of the upper deck?—Yes.

1007. Did it ever freeze there?—Only on the metal bolts that passed completely through the deck, and then only at night.

1008. Was there much drip?—At times considerable.

1009. Was it sufficient to wet the men's bedding, and prevent sleep?—In some parts it would have been, had they not taken precautions to prevent it.

1010. What steps were taken to avoid this drip?—We endeavoured to keep the temperature as equable as possible, and also attempted to direct the vapour and heated air into the uptakes.

1011. What is your opinion of the flesh of the musk-ox; is it palatable?—Some is as good as English beef, but other is not at all palatable.

1012. Have you any reason to suppose that any of the men had such a dislike to it that they did not eat it?—I think it very probable that some did not eat all of it. They did not eat the worst of the meat, but I have no direct evidence to prove it.

1013. Do you look upon the quantity of the fresh meat which you obtained at your winter quarters as advantageous to the health of the crew?—Yes.

1014. It appears in evidence that fewer persons belonging to the "Discovery" were seized with the disease than those on board the "Alert." Have you, in your own opinion, any suggestions to make as to the cause why fewer men on board the "Discovery" were attacked?—None beyond this, that we had more fresh meat, not knowing sufficient of the "Alert," and of what they did in winter, to be able to judge.

1015. Were more men employed on the sledge journey in the "Alert" than in the "Discovery"?—I think that for the spring sledge travelling we had more men away from the "Discovery," as some, that had been frost-bitten on board the "Alert" in the autumn, were not allowed to go.

1016. You yourself were absent from the ship 132 days?—Yes.

1017. (*Dr. Donnet.*) Was the system of ventilation adopted good, towards reducing the moisture in your ship?—Yes.

1018. Did the men complain of any distress in their breathing, from this amount of moisture?—No, I never heard of it.

1019. Were your holds and store-rooms sweet and clean, or did you at any time observe any foul smell arising from them?—No, they were quite clean and free from smell, whenever inspected.

1020. Were they likewise dry, or did any of the condensed vapour arising from the men's lungs, or the galley, or other sources, find its way as water into those holds?—No; the holds remained dry nearly the whole winter; but towards the end frost formed inside the upper part, but remained as frost as long as I was in the ship, inside at the top of the holds, but not on the living deck.

1021. Did you use any disinfectants?—Carbolic acid, whenever it was required.

1022. In what instances was this carbolic acid required?—Wherever water had accumulated, which was in the afterpart of the bilges of the engine-room, and in the tank-room.

1023. (*Admiral Sir R. Collinson.*) The warming apparatus supplied to the "Discovery" was hot water, I believe?—Yes.

1024. Do you think it suited its purpose?—Very well indeed.

1025. You saw the method in use on board the "Alert"; which do you prefer?—I believe the methods to be the same in both ships, at least to be the same with regard to the living deck, for the hot-water stove in the "Discovery" only warmed a passage in the afterpart of the ship.

1026. (*The Chairman.*) Was that passage on the same level as the living deck?—On the same level as the living deck.

1027. Where was it?—It was a passage which provided a communication from the ward-room to the captain's cabin past the engine-room, which occupied the ship right up and down throughout the depth of her; from the ward-room bulkhead aft there was no moisture.

1028. (*Admiral Sir R. Collinson.*) Owing to nobody living in it?—There were two cabins, the captain's and mine, those were the only ones. The frozen condensation formed in the very remote corners of those cabins, but there was no actual moisture.

1029. The cause of the moisture on the lower deck is the number of people inhabiting a confined space, and taking their meals there?—Yes, certainly it is; the number of people living and the steam from the galleys from the dinners, especially when served out.

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1030. (*The Chairman.*) On what day did you join the "Discovery"?—When she was commissioned, the 15th of April, 1875.

1031. And you belonged to her till she was paid off?—Yes.

1032. Enumerate the sledge journeys on which you were employed?—I was employed first in the autumn, September, on board the "Alert," to try and rejoin my own ship; I was only away two days then. Then again in October, for the same purpose, to try and rejoin my own ship; then I was away eleven days. The next journey was in March, when I left on the same service. I was only away four days, owing to the sickness of Petersen. And then again, later in March, when I reached the "Discovery"; taking six days. After remaining four days on board the "Discovery" I returned to the "Alert"; also taking six days. After four days on board the "Alert" I crossed over to Greenland, finding a passage to Greenland, and came back; I think I was eight days on that occasion. Then, after two or three days on board the "Alert," I again went to Greenland under Lieutenant Beaumont, and I reached the "Discovery" after 105 days. That is all the sledging. I was out in tents after that, but not sledging.

1033. (*Admiral Sir R Collinson.*) The only journey you made in the autumn, was that with dogs or with men?—With men.

1034. And what brought you back?—Only having a week's provisions, and seeing that to round the nearest cape to the "Alert" would have taken me with my boat at least three days, I came back to the ship.

1035. Then your next journey was, when?—About three weeks later than that.

1036. And where did you go to?—I reached a place called the Black Cape.

1037. For what purpose?—To try and rejoin my ship.

1038. And what was the occasion of your coming back then?—Having orders not to round any cape where the hummocks might be knocked away before my return. I found this at the Black Cape, and could not proceed with my sledge further; but I walked to Cape Union, past that.

1039. Was the ice then in motion?—Yes.

1040. Did you, in consequence of the thirteen days altogether which you were absent on sledging expeditions in the autumn, perceive any symptoms of scurvy among your crew?—None whatever.

1041. In the early spring you again started to get to the "Discovery"; was it with the same crew?—No, it was not.

1042. Describe to the Committee what sledge and what equipment you had on that occasion?—I accompanied Sub-Lieutenant Egerton, who commanded the dog-sledge "Clements Markham," drawn by eight dogs, and with Petersen.

1043. You were compelled to return in consequence of Petersen's becoming severely frost bitten?—Yes.

1044. Can you tell the Committee how it was that Petersen became frost-bitten?—Owing to the low temperature there; and, also, I do not think his blood circulated as quick as ours did, he being much older than we were.

1045. Was he a Dane, or half-caste?—A Dane, I believe.

1046. You did not experience any open water on that occasion?—No.

1047. Was he as well clad as you were?—Yes.

1048. So that you are of opinion that it was owing to his being too old for the work?—Too old for that very low temperature.

1049. You then reached the "Discovery"?—The next trip.

1050. How many days did you take to get there?—Six, I think.

1051. And when did you return?—We were four days on board the "Discovery," and six days rejoining

the "Alert," and one of those we were detained in our tent by a gale of wind.

1052. How long did you remain on board the "Alert"?—I think four days.

1053. Did you then cross over to the coast of Greenland?—Yes.

1054. And had you the same crew with you that had been with you to the "Discovery"?—I was in command myself of the ladder-sledge called "Arrow," drawn by four men. I also had attached to me the dog-sledge "Clements Markham," commanded by Sub-Lieutenant Egerton.

1055. Was the travelling between the "Discovery" and the "Alert," or that from the "Alert" to Repulse Harbour, very different?—Well, it was in one way. A good part of the travelling from the "Alert" to the "Discovery" was performed along the snow slopes underneath the cliffs, whereas the travelling to Repulse Harbour was straight across the floe.

1056. Which was the most fatiguing to the men?—Along the slopes.

1057. On your arrival at Repulse Harbour, were there any symptoms of disease among your crew?—Not that I know of; one of my men had, I think, a stiff leg. I would not be certain of that without my journal.

1058. It appears in your journal?—Yes.

1059. Then you proceeded to the north-east?—No, not this trip, I returned to the ship; it was only as an engineering party before I started with Lieutenant Beaumont.

1060. This was a reconnoitring expedition you mean?—Yes.

1061. You then returned to the "Alert"?—Yes.

1062. And how long did you remain on board her?—I think two or three days.

1063. Will you describe your equipment when you started with Commander Beaumont?—I was in charge of Her Majesty's sledge "Discovery," drawn by three men. I could not state the amount of provisions.

1064. For the long journey you had a three-men sledge?—Yes, we had relief sledges with us, supporting sledges.

1065. Were those three men the same that had been with you on the previous expedition to the "Discovery" and across to Repulse Harbour?—One of them had been both to the "Discovery" and Repulse Harbour; another one had been to Repulse Harbour with me, and the third one had not been with me at all, but had been to Cape Joseph Henry.

1066. Did they all belong to the "Discovery"?—All those three men did.

1067. You then proceeded to the north-east with Commander Beaumont?—Yes.

1068. How many days did you continue with him?—Until the 11th of May.

1069. On that date did any of your men show signs of scorbutic affection?—George Bryant, the captain of the sledge, complained of being very stiff about the knees and ankles, and Elijah Rayner had fallen on to his knee about a week previous and complained of that a little; but I do not think that had anything to do with scorbutic affection.

1070. The principal cause of your leaving Commander Beaumont, was the illness of Hand, who belonged to the "Alert"?—No; Hand was originally one of my sledge crew which I brought up in the autumn.

1071. Hand spent the winter on board the "Alert" with you?—Yes, on board the "Alert" with me.

1072. But he formed part of Commander Beaumont's sledge crew?—Yes.

1073. And it was his serious illness that induced Commander Beaumont to give you orders to return?—Yes.

1074. Where were you told to go to?—I had open orders, first to proceed to Repulse Harbour, and then taking into consideration the state of the ice, the state of the men's health, and also where Dr. Coppinger had gone, either to proceed to Her Majesty's ship

"Alert," or else make the best of my way down to Polaris Bay, where I knew there was lime juice.

1075. Was the ice, when you arrived at Repulse Harbour, in motion?—Not that I could see; it was thick weather when I arrived there.

1076. What route did you take to get to Thank-God Harbour?—I proceeded along the coast from Repulse Harbour as far as the Gap Valley, where I crossed the land to Newman Bay; and then, crossing Newman Bay, I crossed the Polaris Plain.

1077. What induced you to take that route?—The record I found at Repulse Harbour reported that Lieutenant May had been some way up the Gap Valley, and reported favourably on it as far as Newman Bay; and we also knew that the Americans had found good travelling across the plain from Thank-God Harbour to Newman Bay.

1078. On your arrival at Thank-God Harbour, what was the condition of your crew?—James Hand was in a very serious condition, and George Bryant also, but he had steadily refused to be carried, and managed to crawl on. Michael O'Regan complained of stiff legs, which I afterwards found out from Dr. Coppinger was scurvy; and Rayner was the only man sound.

1079. How was your sledge dragged under these circumstances?—We had deposited every possible thing we did not require, knapsacks and all; and Elijah Rayner, Michael O'Regan, and myself were dragging the sledge with James Hand on it: and George Bryant came along as best he could astern.

1080. What did you do on your arrival at Thank-God Harbour; just describe what steps you took for the recovery of your men?—We pitched our tent close to the American Observatory, and supplied the men with lime juice and preserved meat and vegetables, and that night I made Bryant sleep in the observatory, and Hand died in the tent.

1081. What condition did you find the lime juice in?—We thought it very weak at first; but this proved to be snow which had got into the cask in some way, and on getting deeper down we found it even more bitter than our own.

1082. Was it frozen?—Yes.

1083. How did you get it out of the cask?—Somebody who had been there before had cut a square hole, about six inches by six inches, and we were able through this hole to chop it inside and take it out with our hands.

1084. That "somebody" belonged to the "Discovery"?—Yes; I think it was Lieutenant Archer's party.

1085. It was not done when left by the "Polaris"?—I do not think so.

1086. How long was it before Dr. Coppinger came to you?—I think four days.

1087. Had your men, with the exception of the man who died, showed signs of improvement before Dr. Coppinger's arrival?—No. Bryant, if anything, was rather worse, although we had been able to get him a couple of ptarmigan, and he was supplied with plenty of preserved meat and vegetables, and also as much lime juice as he could drink.

1088. With the exception of Bryant, were your other men improving?—I think so; they had arrived very tired, and they were able to have more rest.

1089. Independent of the rest, to what would you ascribe their improvement?—They hardly improved enough for me to form an opinion in that short time before Dr. Coppinger turned up.

1090. After Dr. Coppinger's arrival what took place?—I asked Dr. Coppinger to examine the body of Hand, as I myself did not think it could be scurvy that he had died from, not knowing that scurvy carried a man off so quickly, but he pronounced it scurvy; after which we buried Hand, and he took charge of my other two patients. They had also brought some seal meat with them, which the Esquimaux had shot, and on this and Dr. Coppinger's care they made rapid progress towards recovery.

1091. You then sent Lieutenant Fulford to the "Discovery"?—No.

1092. Did anything else transpire before you set out to meet Commander Beaumont?—Nothing, except that the Esquimaux was enabled to shoot enough seal to keep all the sick men living on seal meat, as much as they could eat. I went a short trip myself, too, to recover my depôted gear, with the Esquimaux and the dogs.

1093. You then determined that it was desirable that Commander Beaumont should be succoured?—Yes.

1094. What steps did you take to do that?—Lieutenant Beaumont not having arrived by the 22nd, I determined to start with the dog sledge to his relief. Both Dr. Coppinger and Lieutenant Fulford volunteered their services for this; but as the sick were now out of danger, and it might be sickness which caused Lieutenant Beaumont's delay, I accepted of Dr. Coppinger's services, and started with him, the Esquimaux and the dogs, taking with us sixteen days provisions, and also some lime juice in case we came across the sick party.

1095. How many days were you out before you fell in with them?—Three.

1096. What condition did you find them in?—We found Lieutenant Beaumont and two men (Alexander Gray, one of the ice-quartermasters and captain of the sledge, and Jones, stoker) the only three able to pull, the other four men having to be carried. The whole party had scurvy more or less, even the ones who were pulling.

1097. Commander Beaumont in his evidence has referred us to you as to the condition in which he was when you met him?—Medically, I could not say, but Dr. Coppinger was with me. He certainly was very stiff. Dr. Coppinger would report about him.

1098. How was he with regard to his spirits?—I think he was very glad to get relieved; although keeping up his men's spirits to the best of his ability.

1099. How long were you in getting the party to Thank-God Harbour?—Two men were sent in on the 28th, I think, and the remainder of the party we got in, I think, by the 1st of July.

1100. What then occurred?—A few hours after the first two men had got in, one of them, Paul, died; and the remainder of the men on lime juice, fresh seal meat, and Dr. Coppinger's care, soon made rapid progress.

1101. Then you communicated with the "Discovery"?—Lieutenant Beaumont sent Lieutenant Fulford, two men and the dogs over about 10 days later on, I think.

1102. And Captain Stephenson came over to you?—Yes.

1103. What then occurred?—Captain Stephenson remained with us about 10 days, and then I returned to the ship with him, taking two of the men who had been ill with the scurvy, and leaving two of his healthy men to assist Lieutenant Beaumont.

1104. You got back to the ship after 105 days' absence; or was that 105 days' absence from the "Alert"?—From the "Alert" to the "Discovery," 105 days.

1105. To your own ship it would be how many; the last time you left the "Discovery" till the time when you got back to her?—On the 30th of March I think I left the "Discovery" the last time; the number of days was 126 days.

1106. (*Admiral Inglefield.*) Had you any instructions from the medical officers of your ship as to symptoms of scurvy, how to recognise them when they broke out, and the remedies you should apply?—No; we were told that the officers of the sledge crews were to make themselves acquainted with scurvy grass.

1107. Did you find any on your journey?—None.

1108. Did you suffer yourself from scurvy during the journey?—No, not that I am aware of.

1109. How many men besides yourself were thus free in your whole party?—Out of Lieutenant Beaumont's sledge crew, and my own together, only one.

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1110. To what do you attribute this immunity from what attacked the others?—I have no idea.

1111. Had you had much opportunity of getting seals' meat or game; I see you killed a ptarmigan once?—We never got any game until arriving at Polaris Bay, with my sledge crew.

1112. What lime juice did you carry with you, and how was it served out?—None whatever, when we left the "Alert."

1113. What medical comforts and medicines did you take with you?—No medical comforts. Of medicines there were several contained in a small box.

1114. You say that you had no instructions with reference to the treatment of scurvy, if it broke out; do you think if you had had a doctor with your sledge party your sick men would have received much advantage from his services?—I hardly know; I do not think he could have given them anything, not having it with us.

1115. Did you immediately recognise the scurvy when the first symptoms broke out?—No, I did not; I did not know anything about it, but Lieutenant Beaumont knew more about it, owing to their having scurvy on board the "Discovery" during the winter.

1116. Can you suggest any alterations in the equipment of a sledge after your recent experience, or a better form of cooking apparatus?—I think the cooking apparatus might be improved.

1117. In what way?—We had to alter ours in order to put the stearine in. In the way it is fitted now, you always have to take the kettle off the fire to feed it with stearine, and this causes a great waste of heat.

1118. What was the nature of the alteration that you made so as to feed the stove with stearine without having recourse to removing the kettle?—There were two alterations made; one was fitted so that you could draw the spirit lamp out by means of having it rested on a small slide; but this weakened the bottom of the cooking apparatus. The other was a small funnel, or shoot, down which you could drop the stearine into the lamp without removing the kettle.

1119. Can you give the Committee any information on the subject of the present inquiry, which your experience has suggested; the present inquiry, of course, being into the cause of the outbreak of scurvy in the expedition?—I think it is due a good deal to the darkness: also the dampness during winter of the decks; and also the preserved meats not being as good as they are supposed to be in the way of preventing scurvy; and sleeping in the intense cold also tends to it.

1120. Do you consider that you had a sufficient quantity of meat issued to the men?—Yes; quite.

1121. And were they able to eat their full allowance?—No; I believe not, though we were in the ward-room.

1122. Did you carry many private stores amongst the officers, which afforded you advantages over the men in the way of provisions?—There was a ward-room stock, and I think a few of the officers had a private store, but very little.

1123. Do you consider that the men who had been acclimatised by previous voyages to the arctic seas had an advantage over those who had never visited the arctic regions before?—No, none whatever.

1124. Do you think individually, that you would be better able to meet the rigours of an arctic climate, having now had some experience in those regions?—If I were still young, I think I should, because I should know what to take.

1125. Then I gather from you that experience in the arctic seas is advantageous to a voyager in those regions?—Certainly; experience is advantageous.

1126. (*Dr. Donnet.*) In your four days' journey with the object of rejoining your ship in March, you mentioned the sickness of Petersen; on what day after leaving was he taken ill?—The second day.

1127. I believe you said that you considered Petersen too old to be exposed to the low temperature;

what temperature did you experience, and what was the age of Petersen?—Lowest temperature was -34° , I think. Petersen's age was, I think, 43 years.

1128. Was he in good health at the time of leaving the ship?—I believe so.

1129. When taken ill what symptoms did he present?—He had pains in the stomach and the chest too I think.

1130. Do you think that the pains in the stomach were produced by his eating snow?—I do not think up to that time he had eaten any snow, or not to our knowledge.

1131. You mentioned pains in the chest; did you remark a difficulty of breathing?—Not the second day, I think, or not till the end of the second day.

1132. Had not Petersen been in Dr. Kane's expedition; and can you inform the Committee whether he had suffered from scurvy at the time?—I am not sure whether he was in Dr. Kane's expedition or not, but he was either with him or with Hayes. I do not know if he had scurvy when with them.

1133. Do you think that he was suffering from scurvy or from frost-bite?—Frost-bite; and I believe the doctors told us when we returned to the ship that his lungs were affected.

1134. What precautions did you take with regard to him in the state in which he was after he was taken ill?—The first night that he was taken ill we wrapped him up and laid him between us; we also gave him the preserved meat which we had for the dogs instead of pemmican, as he could not eat the pemmican; and the next day, as it was blowing a gale of wind, we dug a hole, and covering it over with the sledge placed him inside, and then covered it over with everything and lit up the spirit lamp, and cooked inside so as to raise the temperature.

1135. After leaving Commander Beaumont, what men had you besides these forming your party on your sledge?—Only one, James Hand, who was not on my own sledge when I left Lieutenant Beaumont, but who had afterwards to be carried.

1136. He accompanied you, however, to Thank-God Harbour, and your object in visiting that harbour was to supply him with lime juice?—Yes, and also to meet Dr. Coppinger.

1137. On what day did you arrive at Thank-God Harbour?—The 3rd of June, I think.

1138. You mention having found lime juice there; was it in good condition?—It was frozen, and the upper layer had evidently been mixed with snow, frozen with snow, as it was very weak; but as we got down into the cask it got stronger and stronger.

1139. Was this weakness due to any admixture with snow, and was the lime juice in the cask exposed to the open air?—There was only a crack where this small lid was cut out.

1140. Could the snow get into that?—Yes, a little snow could get in.

1141. Did you take lime juice when on board?—Yes.

1142. Have you formed any idea about its value as an antiscorbutic?—Yes; I think it is a good preventive; but as there was scurvy on board the ship where they took lime juice, I do not think it can be as good as they say.

1143. Do you think that the men were benefited by the lime juice given to them at Thank-God Harbour?—Yes; I think that added to the quickness of their recovery.

1144. Did the men seem to take it with pleasure?—At Thank-God Harbour they did.

1145. What were you able to do for Hand before Dr. Coppinger's arrival at Thank-God Harbour?—Nothing, except give him lime juice. The day before we got to Polaris Bay, not having enough provisions to go on with, we walked on to try and find the depot, which we did, and brought back some preserved meat and vegetables and lime juice for Hand and Bryant, whom we had left in the tent. The next day we got him into Polaris Bay at 4 p.m. We were able to give him some more preserved meat and vege-

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tables, though he could hardly eat any, and lime juice, and he died between 10 and 11 that night.

1146. What were the symptoms which you observed in this man during his illness?—Shortness of breath and great giddiness. His teeth became loose, two falling out; his legs and arms had blue patches on them, and his breath was very offensive; and the last two or three days he was alive he several times talked a little wildly; he was delirious.

1147. Besides Hand, did others of your party suffer in like manner, or in a less degree?—George Bryant was in a very critical position too, but not so bad as Hand, by a long way; and Michael O'Regan also had a touch of scurvy, being very stiff about the knees and legs.

1148. Did you perceive any sensible benefit in the health of these men after they had been supplied with lime juice and preserved meats on arrival at Thank-God Harbour?—They were only four days there before the Esquimaux came in and got seal meat for them with Dr. Coppinger; they then made rapid progress.

1149. Was lime juice likewise given with the seal meat?—Yes.

1150. What was the state of their health on arrival on board their ship?—O'Regan was stiff, and I believe was put in the list by the doctors on arrival; but George Bryant, who did not arrive till some time afterwards, I think, was not put on the sick list when he got back.

1151. Did you suffer from any symptoms of scurvy; I ask the question, as in your 27th journey you mention "the bandage on my knee has perfectly cured me"?—I do not think I had any symptom of scurvy, but the sinews of one of my knees had been rather strained, and I bandaged it for that.

1152. Did you suffer from snow-blindness?—Yes, twice.

1153. What remedies did you use against it?—Wine of opium.

1154. Did your medical instructions afford information as to the treatment of casualties?—Yes.

1155. But not for scurvy?—No, not for scurvy; with the exception of the mention of scurvy-grass.

1156. You say you did not find any scurvy-grass; did you find any sorrel or cranberries, both of which grow in the arctic regions?—Later on we found a good deal of sorrel, but no scurvy-grass or cranberries to my knowledge.

1157. Besides the darkness, and the qualities of the meat supplied, do you think that other causes acted to produce scurvy?—I think that the lowering of the system by sleeping in that intense cold may have had a good deal to do with it; also the work.

1158. Do you think that rum is a necessary article in sledge travelling?—I think it is a very good thing, if taken at night just before you turn in.

1159. Does it help the men to sleep better?—I think so; and certainly it cheers them.

1160. What is your opinion of tea as an article of this diet?—I think it could not be spoken too highly of.

1161. Had you any total abstainers in your party?—No.

1162. You had, therefore, no means of judging whether total abstainers would support a greater amount of fatigue than those who drank spirits?—No.

The witness withdrew.

COMMANDER LEWIS A. BEAUMONT, R.N., further examined.

1175. (*The Chairman.*) It is understood that the Admiralty appointed a committee, consisting of Admirals Richards, Sir Leopold McClintock, and Sherard Osborn, to report to their Lordships on: first, the special equipment of the ships; and, secondly, the instructions for the conduct of the expedition. In the copy of the said memorandum, having numbered the paragraphs, I request that you will state, as I read them *seriatim*, whether the suggestions and recommendations therein contained were carried out, or, if otherwise, to what extent, and the grounds on

1163. (*The Chairman.*) Were the medical instructions you took printed, or were they written instructions furnished by the surgeon of the ship?—They were written; we copied them into our journal; they came from the surgeon of the ship.

1164. You have stated that the preserved meat was not so strengthening as pemmican; but was it perfectly good of its kind?—I believe so.

1165. Is there any difference between the American and the English pemmican, and if so what is it?—A great deal of difference; the American pemmican being much coarser, and you often came across pieces in it which the men called "hoofs and horns," also nails; and therefore it was not so good.

1166. You stated that spirits cheered the men up of an evening; would tea have been equally good for the purpose?—They took their spirits in the tea; they had both.

1167. Can you suggest any mode in which lime juice can be carried so as to admit of being conveniently used under the very low temperature incident to your spring journey?—Only if it can be taken in a condensed form, and like an acidulated drop, or something like that, so that it requires no spirits of wine to thaw it.

1168. Assuming lime juice to be carried and used in the mode you have described, state the addition it would make to the weight to be carried on the sledge?—If they could condense it, and also the sugar with it, into such a form, I do not think it would be very much weight.

1169. Commander Markham has stated in his evidence that his party were generally up to their knees in the snow, and very frequently up to their middles; had you much travelling of that description?—In the autumn all my travelling was like that, but in the spring only at times. Crossing the Polaris Plain, the whole way across we had it about half way up to our knees, that is about a foot, with a crust on the top which you had to break through.

1170. Would snow-shoes have been of any advantage to you, and if so, state the description of snow-shoe, you would recommend?—I had one pair of snow-shoes, Canadian snow-shoes, on my sledge in the spring, but only used them once. I do not think you could drag over the rough ice with snow-shoes on.

1171. (*Dr. Donnet.*) Have you any suggestions to make with regard to the diet of arctic ships, with reference especially to a greater quantity of fatty matters, butter and condensed milk?—I think both butter and condensed milk would be good things.

1172. Or other forms of preserved vegetables?—I think more vegetables would be a good thing.

1173. (*The Chairman.*) Generally speaking, were you entirely satisfied with the equipment of the "Discovery" for the special service in which she was engaged?—Yes, generally speaking.

1174. Will you furnish the Committee with the following returns, the forms of which will be provided for you by the Secretary: first, a meteorological return for those sledge journeys in which you were in command; second, a return showing the details of your sledge work; and, third, a return showing the distance travelled and made good during your sledge journeys?—Yes.

which they were not fully complied with. Proceeding to the 4th paragraph: "When it may become necessary to recruit men after great or unusual fatigue, either in working a ship through the ice after midnight, or on long marches when travelling, I consider cocoa or tea infinitely preferable to spirits, hitherto generally given, and I think the use of the latter should be abandoned on such occasions as far as practicable." Was this recommendation carried out?—Yes.

1176. Proceeding to the 5th paragraph: "When in

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winter quarters, daily exercise should be rigidly enforced on all whose duties do not require them to remain on board, and the hours between breakfast and dinner and between dinner and supper should be entirely devoted to it, or to work, as may be necessary, outside the ship, so as to ensure about six hours' exercise during the day. The indoor workers, commonly termed 'idlers,' will, if permitted, evade exercise, but it should be enforced on them at periods when they are not required on board." Was this recommendation carried out?—Yes; but it did not amount during very severe cold to six hours; it was a little less; five hours, I think, I made it.

1177. Were the men intended to form the sledge parties exercised during the winter, so far as practicable, with a view to that service?—All the ship's company had the same exercise; there was no difference; they all worked. The exercise was not merely walking exercise, but it was actual road making and constructing, and dragging ice, and dragging snow on sledges, besides the walking exercise.

1178. (*Dr. Donnet.*) Did the nature of the ice over which these men worked add to the exercise, and would you describe this ice?—No; the ice over which the work was carried out did not present any difficulties which increased it; but it was the ice of the harbour. There were hummocks, but those could be avoided; and as our object was to bank the ship up with snow, or to collect ice for constructing the different buildings, we took the best roads. We did not look for difficulties, and we carried out the work with the greatest facility.

1179. (*The Chairman.*) Proceeding to the 6th paragraph: "A periodical monthly examination of the ship's company, after being settled in winter quarters, should be carried out, as the earliest signs of debility or scurvy will be readily detected thereby, and immediate measures may be then taken to arrest it." Was this recommendation carried out?—An examination of the men was made during the winter; but I could not say at what periods. Whenever I was applied to to send the men, I always did; but I am not sure how often the doctors carried it out.

1180. (*Dr. Donnet.*) Did these inspections relate to the general state of health of the men, or had they reference likewise to their cleanliness?—Both, I believe.

1181. (*The Chairman.*) Proceeding to the 7th paragraph: "The necessity of keeping the atmosphere of the lower deck as pure as circumstances will permit, is obvious, and the escape of foul air should be promoted to the greatest possible extent, and the maintenance of as much warmth and dryness as possible is most essential." Was this recommendation carried out?—As much as possible; and, may I add, that it was always kept in view.

1182. (*Dr. Donnet.*) Was the ventilation of your ship as perfect as it could be made in those regions?—We tried to improve it by all the means we had, and we tried experiments, but it was never perfect.

1183. As perfect as it could be in those regions?—I can hardly tell what amount of perfection could be arrived at. As far as our knowledge went, everything was done that could be done.

1184. (*The Chairman.*) Referring to this recommendation, Captain Stephenson states in his report, at paragraph 36, that it was necessary to stow the hammocks in the hold, having found that stowage on deck rendered them damp when taken below; what was the result of this mode of stowing the hammocks?—That the hammocks remained dry after being brought up out of the hold, whereas when they were brought down from the upper deck, the heat of the body which had remained in the hammock in the morning and frozen during the day, thawed and made the hammock quite wet about a quarter of an hour after it had been down below on the lower deck. By keeping it in the hold that was done away, and the hammock remained dry.

1185. Further, from a paragraph at page 18 of Sir

George Nares' report, under the head of "Health," and from paragraphs 35 and 37 of Captain Stephenson's report, it would appear that absolute dryness was not obtained on the lower deck; will you state to what extent this defect existed?—It only existed on the living deck; and it was chiefly at the time that the meals were served, more especially at dinner, when the steam arising from the dinners that were laid on the tables formed a moisture on the beams in such quantities that it fell in drops on to the deck and wetted the deck considerably. It got much drier in the evening after the cooking had ceased, but recommenced again after the men had been some time in their hammocks, probably owing to their breath being so close to the beams, but not in such a quantity.

1186. Proceeding to the 8th paragraph: "Under the generally depressing influence of arctic service, the importance of promoting hilarity and cheerfulness as sanitary agents is paramount." Was that attended to?—Yes.

1187. Proceeding to the 9th paragraph: "Men, before they are selected for sledge or travelling parties, should be examined by the medical officers, as to the existence of any defect, that might possibly render them inefficient, and they should be again examined on their return to the ship." Was that strictly carried out?—It was on their starting to my knowledge; and I believe it was when they came back; but I was not on board the ship then, so that I can only say I believe so.

1188. Proceeding to the 10th paragraph: "A small supply of such surgical appliances and medicines as might be considered by the senior medical officer of the ship suitable for meeting slight ordinary casualties and illness, with clear and well defined instructions for use, should be placed in charge of the officer commanding the party; and the petty officers in charge of the sledge should be practically instructed in the use of such appliances before leaving the ship." Was that carried out?—Yes.

1189. And these instructions were generally made known to all the men who travelled?—The medical instructions, do you mean?

1190. Yes?—No, I do not think they were; but the fact that there were medicines, and the existence and the use of the instruments, the men knew of.

1191. Proceeding to the 12th paragraph: "Snow-blindness should be carefully guarded against in travelling on excursion parties during the spring and summer months. After the sun reappears, veils, or neutral-tinted glasses, or goggles, should be worn, to obviate the occurrence of this painful and troublesome affection, a severe attack of which at once renders men for a time inefficient, as it comes on as a rule suddenly, if the eyes are much exposed to the combined influence of snow and sunshine." What measures were taken in regard to this recommendation?—From the time that the first effect was felt, the men wore glasses regularly, the neutral-tinted glasses, in my party.

1192. Proceeding to the 13th paragraph: "Men should at once make known to the officer in command, the occurrence of this, or any other casualty, however slight, the moment they are aware of it. Total exclusion from light, by bandaging the eyes, and the application of ice or cold lotions, will be found efficacious in the treatment of snow-blindness." Were these measures strictly enjoined on the officers and men proceeding on the sledge parties?—Yes; but I never had a bad case in my party.

1193. Proceeding to the 14th paragraph: "As accidents may frequently occur from the careless use of fire-arms, a field tourniquet should always be supplied to travelling or shooting parties, and some intelligent person instructed in its use." Was this suggestion carried out?—Yes.

1194. Proceeding to the 15th paragraph: "Frost-bites will be of frequent occurrence, chiefly on the exposed parts of the face, hands, and feet. Nothing can be better to restore the circulation in the frozen part than gentle friction with the hand. If the feet

or hands are extensively frost-bitten, great care should be taken not to use stimulating applications in the first instance, otherwise acute inflammation, followed perhaps by mortification of the part, is likely to ensue. Should this unfortunately occur, then the disease must be treated on general principles." What measures did you take in regard to this suggestion?—I was not called upon to do anything with regard to this, as we had no frost-bites. With regard to the measures taken on board the ship, I can say that every officer and man was instructed how to deal with frost-bites.

1195. Proceeding to the 16th paragraph: "Each ship will be supplied with a few copies of the Medical and Surgical Handbook, issued from this department for the use of small ships not carrying medical officers, which, although of too comprehensive a character for arctic service, yet, as directions are laid down for meeting casualties and slight diseases, I think it will be found of much use to officers on detached service, and where no medical assistance is available." What use was made of these books?—I am not aware.

1196. Proceeding to the 17th paragraph: "A copy of a book published by me on naval hygiene and scurvy, embodying my experience of this disease, will also be supplied to each ship, and will, I hope, furnish a suitable guide in its treatment should it unfortunately occur." Was that supplied to the medical officers of the ship?—I am not aware.

1197. Proceeding to the 18th paragraph: "As a convenient mode of applying ice in cases of snow-blind-

ness, I have directed a supply of goggles, specially made for the purpose, to be furnished to each ship for the use of the travelling parties; also several sets of splints, light, portable, and well adapted to meet the occurrence of casualties when absent from the ship. Both these appliances were invented by the late Surgeon-Major Wyatt, C.B., and will, I hope, prove as useful as I anticipate." In regard to these can you afford us any information?—Not as to my party, for we never used them; though they were supplied, and we carried them, we never had occasion to use them.

1198. Will you furnish the Committee with the following returns, the forms of which will be supplied to you by the Secretary: first, a meteorological return; second, a return of sledge work; and, third, a return of distance travelled on your sledge journeys?—Yes. (Appendix 16.)

1199. You have stated that you found the preserved meat not so efficient for sledge work as the pemmican. Was the preserved meat good of its kind?—Yes, very good. I have stated that it would take a large proportion of preserved meat to be equivalent to the allowance of pemmican.

1200. Had you the same journeys to undertake again, would you be disposed to diminish the length of the day's work?—Under the same circumstances I would shorten each day's journey, believing that in the end it would contribute to maintaining the health of the men, though the distance travelled would be less.

The witness withdrew.

LIEUTENANT GEORGE AUGUSTUS GIFFARD, R.N., *examined.*

1201. (*The Chairman.*) On what day did you join the "Alert"?—25th April, 1875, the day she was commissioned.

1202. And you continued to belong to her till she was paid off?—Yes.

1203. Enumerate the sledge journeys on which you were employed?—First, a supporting sledge to Lieutenant Aldrich; that was from the 3rd of April to the 3rd of May. The second was from the 7th of May to 24th of May.

1204. Will you state the purport of that second journey?—The second journey was for laying out depots for the advanced sledges.

1205. (*Dr. Donnet.*) In your journeys, how did you find the snow?—Soft and deep.

1206. Did your men suffer much from the difficulties which they encountered from the softness and the depth of snow, and would you describe what the depth was?—They suffered, inasmuch that it made their legs ache; it did increase the labour of dragging; not more than that. We sank into the snow from a little below the knee to above the knee, where the snow was deep, and at other times, or I may say always, ankle deep.

1207. Had you any illness amongst your men?—Yes; on the second journey, two of the men were brought back to the ship on the sledge suffering from scurvy.

1208. What were the symptoms of these two men?—The first man who was taken ill began with pains in the upper part of the leg, between the knee and the thigh, and the second man began in the ankles. The stiffness and pains gradually got worse. In the case of the first man, the upper part of his leg was slightly discoloured, and they both suffered from sore gums.

1209. Did you notice any shortness of breath, or any offensive smell from their breath?—I noticed the shortness of breath of one man only after taking him out of the snow-house in which I had been obliged to leave him.

1210. Were you made aware at once that the symptoms were those of scurvy?—No.

1211. You think it was merely the result of fatigue and the hard work they were undergoing?—Yes, I thought so.

1212. Were they able to continue their work?—They gradually did less and less, till they finally broke down altogether.

1213. Had you any means of assisting these men; were you supplied with medical instructions and medicines?—Yes.

1214. Did you use any of them in the case of these men?—Yes.

1215. What did you use for their legs?—I used turpentine liniment, and warm water and bandages.

1216. (*The Chairman.*) Were the medical instructions with which you were supplied printed, or furnished by the surgeon of the ship?—Furnished by the surgeon of the ship.

1217. (*Dr. Donnet.*) What was the lowest temperature you recorded?—To the best of my recollection, — 45°.

1218. Did this extreme cold tell upon the health of the men, and add to their fatigue?—Apparently not; it gave the men less sleep.

1219. Did they suffer from snow-blindness?—As far as I remember, I think I had two or three very slight cases; practically nothing.

1220. What were the names of the two men who returned to the ship on the sledge?—William Lorrimer, and William Wolley.

1221. Can you make any suggestions with regard to the sledge dietary?—Merely as regards the health, an allowance of lime juice.

1222. Had you any on any of the journeys in which you were engaged?—On the second journey I had an allowance of lime juice.

1223. What is your opinion of this article as an antiscorbutic?—I think it a great assistance in helping to keep off the scurvy.

1224. Did you remark any craving amongst your men for the lime juice?—The two sick men were continually asking for it.

1225. And were you able to supply them with it?—They were supplied with as much as they wanted.

1226. Did any benefit arise from this supply?—I may say that I could not observe any improvement, because they were getting worse day by day.

1227. Did those men ultimately recover?—Yes.

1228. Had you any case of severe frost-bite?—No.

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1229. Have you formed any opinion upon the value of spirits in an arctic sledge journey, and do you consider them necessary?—I think the men would very much feel the want of them.

1230. At what time of the day did you give the spirits to the men?—After supper, just before going to sleep.

1231. Did your men as a rule sleep well?—Yes; that is to say, as well as you could sleep there; not the same as you could sleep in a bed.

1232. Had you any experience of the use of tea in a sledge journey?—Yes; I think it is the best drink that we had; it always seemed to refresh the men very much, and was what they always looked forward to most.

1233. Do you consider that lime juice should form a necessary article in any future sledge dietary?—Yes.

1234. It has been given in evidence, that lime juice would add to the weights; would you substitute it for any other article now carried, such as spirits?—No.

1235. You mentioned an allowance of lime juice having been given to the men; was this a daily ration, and in what quantity was it given?—Yes, and to the best of my recollection, it was an ounce daily.

1236. Were not the men benefited by this ration?—Not apparently; not so far as I could see; they did not very much care for it.

1237. Did your men suffer from thirst?—On the whole, No.

1238. Had lime juice been given to the men previous to becoming subjects of scurvy?—Yes, it was given during the whole of my second journey.

1239. Had these men taken the lime juice before they fell ill?—Yes. The first man was ill the day we left, or the next morning.

1240. Was there anything in the man's constitution that led you to believe that he was suffering from any ill health at the time of leaving the ship?—No; he told me that he had never had a day's illness in his life.

1241. Had he undergone much fatigue?—Not more than any other man.

1242. Was there, in your opinion, anything to which to attribute this outbreak of scurvy in these two men?—The want of fresh vegetables, the very small quantity of fresh meat that we had, the long

absence of the sun, and the want of sufficient nourishing power in the preserved meat and vegetables.

1243. Were not all the ship's crew subjected to the same want?—Yes.

1244. Had you many cases of scurvy amongst the men who had not travelled?—I cannot speak from my own knowledge. I never examined the doctor's sick list. I only knew what the general report was. I do know of one, and that was the ship's steward, and I have heard since that our own steward was supposed to have had it, but that is merely hearsay.

1245. Had the men of your party who suffered been on previous sledge journeys without lime juice?—Yes.

1246. In the case of the two who suffered from scurvy could you inform the Committee how many days they had been absent on journeys without lime juice?—They had been twenty-nine days without lime juice.

1247. (*The Chairman.*) When you gave your people spirits was it mixed with the tea or given them separate?—Separate.

1248. Can you suggest any mode in which lime juice can be carried so as to admit of being conveniently used under the temperature incident to your spring sledge journey?—When required to be used in low temperatures each day's allowance should be taken in a separate bottle, which would cause a great increase of weight, and also a considerable addition to the fuel and loss of time in making the water necessary to drink it.

1249. If you had the same description of sledge journeys to undertake again, would you be disposed to diminish the length of the day's work?—Not the length of any days' journeys performed by me, my daily journeys being shorter than those performed by the advanced sledges.

1250. Will you furnish to the Committee the following returns, in the forms which will be given you by the Secretary, for those journeys in which you were in command: first, meteorological return; secondly, return of sledge work; and thirdly, return of distance travelled?—I will produce them. (Appendix 17.)

1251. Were you entirely satisfied with the equipment of the "Alert" for the special service on which she was employed?—Yes.

The witness withdrew.

Adjourned to to-morrow at 11 o'clock.

TUESDAY, 16TH JANUARY, 1877.

PRESENT:

ADMIRAL SIR JAMES HOPE, G.C.B., in the Chair.

ADMIRAL SIR R. COLLINSON, K.C.B.

VICE-ADMIRAL, E. A. INGLEFIELD, C.B., F.R.S.

JAMES J. L. DONNET, ESQ., M.D., Inspector-General of Hospitals and Fleets, R.N.

THOMAS R. FRASER, ESQ., M.D., F.R.S.E.

H. J. VANSITTART NEALE, ESQ., Secretary.

COMMANDER PELHAM ALDRICH, R.N., *examined.*

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1252. (*The Chairman.*) On what day did you join the "Alert"?—On the 15th of April.

1253. Did you belong to her till she was paid off?—Yes.

1254. Enumerate the sledge journeys on which you were engaged?—I was away on three occasions with the dog-sledge in the autumn; the first was only a preliminary trip with the Commander, and back the same day, it was merely a run out and home; the second was on the occasion of advancing a dépôt about 20 miles from the ship, which occupied me five days; and the third occasion was when I went to explore an overland route for the spring sledges, when

I was away, I think, 15 days. In the spring, I left on April the 3rd and returned on the 26th of June, 84 days.

1255. (*Admiral Sir R. Collinson.*) Had you the same crew with you throughout the autumn journeys?—Not altogether; on the preliminary trip, Petersen and Frederick; on second occasion, Ayles, Simmons, Petersen, and Frederick; on the third, I did not take Petersen.

1256. The men had not such heavy work in the autumn as they had in the spring, in consequence of its being a dog-sledge instead of an eight-man sledge?—The only really hard work in the autumn was on the return journey from Cape Joseph Henry, when,

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owing to the snow, which had been falling for some days, it was too deep for the dogs to be of much use with the sledge, and a great deal of labour fell on the men in consequence.

1257. Were there any symptoms of disease in consequence of that heavy work?—No.

1258. Did you suffer from frost-bite on the autumn expedition?—No.

1259. The spring journey equipment consisted of an eight-man sledge, including yourself?—Yes.

1260. What was the weight per man dragged?—At starting, 242 lbs., and when the duffle jumpers were put on the sledge, that brought it up to 247 lbs.

1261. In your progress outwards, I see that you had to send back Elias Hill, on the eighth day after leaving the ship; what was the matter with him?—I am unable to say exactly what was the matter with him. There was at that time a surgeon with the sledge, and it was by his advice that the man was returned to the ship. In his complaints to me he said he was suffering from difficulty of breathing, and pain in the chest and stomach, which I attributed to overstraining, being a very hard-working man.

1262. Then it was in accordance with Dr. Moss's recommendation that he returned to the ship?—Yes.

1263. Whom did you take instead of him?—David Mitchell (able seaman).

1264. After Dr. Moss left you, the expedition under your command consisted of two sledges?—Of two sledges to, I think, the 25th or 26th of April.

1265. And then the "Poppie" returned to the ship?—Yes; I think we made the last journey on the 25th together, and the "Poppie" returned on the 26th.

1266. What was the condition of your men when Lieutenant Giffard parted company with you?—In very good health, with the exception of Joseph Good, who had at times been subject to slight attacks of diarrhoea and looseness.

1267. But not sufficiently ill, in your opinion, to exchange him for one of the crews that were returning?—No.

1268. When did the scurvy first make its appearance among your crew?—On the 30th of April. After a very heavy march, the Sergeant showed me his ankle, which was swollen and discoloured, but I did not attribute it to scurvy then. On the following day the discolouration had spread to the thigh, but beyond stiffness of the limbs and discolouration, no further symptoms of scurvy exhibited themselves until on the return journey. I think that the next case was that of James Doidge, on the 7th of May, who was attacked in the knee, and after that the whole of them became more or less attacked, with the exception of Ayles and Mitchell, but not to such an extent as to lead me to think that it was anything more than the ordinary stiffness accompanying sledging, with the exception of the discolouration, for which I could not account.

1269. When did you come to the determination that it was scurvy?—On the appearance of sore and tender gums, which, I think, must have been about the latter end of May, or the beginning of June.

1270. I perceive that the sledge party under the command of Captain Markham, were attacked at a much earlier period after leaving the ship than your party were. Can you give the Committee any opinion as to the reason for this circumstance?—No; except from the fact of the Northern Division having such a very rough and extraordinary road to travel over, and the crews being more subjected to sudden jerks and strains on the drag-belt than my own crews; who, although they had heavy dragging, were not impeded by hummocks, and therefore were subjected to a very much steadier strain.

1271. Were the equipments of the service precisely the same?—The Northern party carried two boats, the Western none; in other respects the tents and equipments were the same, and the only difference in the provisions, which I know of, was, that the Northern Division took a small quantity of lime juice, which I did not.

1272. From the experience which you gained, would you carry lime juice now?—I think it is impossible for me to say whether lime juice would or would not have prevented the scurvy, it not having been used. If it be proved that it would, I think every sacrifice in length of journey and distance completed would be worth making in devoting the extra time which would be necessary to the preparation of lime juice in cold weather.

1273. Did you travel for the most part on sea, or on land?—My journeys were rather of longer distance on the sea.

1274. Which do you prefer for sledge travelling?—It depends upon the state of the ice. In some places the hummocks and road make the land infinitely preferable; in other cases nothing could be better adapted for sledge travelling than that on sea.

1275. From the nature of the hummocks which you met with, is it your opinion that the shore is steep to, or shelving?—After passing over the land just immediately south of Cape Joseph Henry, I met with no hummocks at all. The land was invariably sloping from the hills down to the ice, the heavy hummocks being kept off at a distance of two or three miles from the hills, apparently either by shallow water, or from the pressure being taken off the coast by cushions or fenders of land which were in many cases met with off the different points, and sometimes extending along the coast-line for a few miles.

1276. Was the pressure of the ice on the coast greater to the eastward or to the westward of Cape Joseph Henry?—I did not round Cape Joseph Henry.

1277. Speaking of the whole coast-line you went along, was the ice of a similar character between the ship and Cape Joseph Henry, as it was to the westward of Cape Joseph Henry?—No; the ice between the ship and Cape Joseph Henry was broken up into floes, with fringes of hummocks between them, through which the sledges picked their way to the depôt at View Point. After leaving View Point, and crossing the land south of Cape Joseph Henry, there was a broad belt of apparently smooth ice, but covered with very deep snow, which lasted to the end of my journey, and which existed between the land and the line of heavy hummocks, two or three miles distant. To the westward of Cape Joseph Henry the heavy hummocks were kept off the land, leaving between an apparently level floe covered in deep snow, along and over which I travelled. Had my route laid to the north instead of following the land, I should at any time have got on to similar ice as that which the Northern party were experiencing in their journey just east of Cape Joseph Henry. The point farthest to the westward, up against which the hummocks were piled, was Cape Joseph Henry.

1278. Have you any reason to suppose that the ice ever moves off from the north coast line of Grinnell Land?—I think it possible, in fact certain, that the crushed ice, which exists north of the level floe, over which I was travelling, moves with the current, and may, under certain conditions, go a short way off; but my general impression is, that the floe over which I was travelling does not break up entirely, and that it would be impossible for a ship to navigate round the north coast.

1279. Had you any difficulty in getting from the ice to the land in consequence of the ice foot?—There was no regular ice foot; the land sloped gradually down to the ice, and in many cases it was difficult to decide when you left the floe and reached the land.

1280. Is the ice foot occasioned, in your opinion, by the fact that the coast is steep to?—There is no ice foot.

1281. But there was opposite the ship?—That only lasted for a very short distance.

1282. Will you explain to the Committee why there should be an ice foot on one part of the coast and not on the other?—The water was not "steep-to," where we were in winter quarters; the ship was in four and a half fathoms, I think. It is possible that

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in the summer we might have found an ice foot existing on the north coast of Grant Land also; but during the time of my sledge journey, from the depth of snow, I could observe no ice foot at all, as the land sloped gradually down to the ice.

1283. The expedition was provided with what was called a ladder sledge, was it not?—Yes.

1284. Had you ever any occasion to use it?—I never saw it used, but I believe it was used in my absence.

1285. That was to climb the ice foot, was it not?—No; it was used for laying out depôts; there was no necessity for using a ladder sledge to get on to the ice foot, as far as I saw.

1286. Has the rise and fall of the tide anything to do with the ice foot?—I should think it may have, to a certain extent; the rise and fall was not very great, being a little over two feet at spring tide at our winter quarter.

1287. Had you any difficulty in consequence of the cracks between the ice and the shore on returning in getting from the land to the ice, or from the ice to the land?—None whatever; the cracks, where they existed, were small, from a foot to eighteen inches wide, and sometimes less, and in several cases we came across no cracks at all.

1288. You mean, you never suffered from falling into the water during the spring expedition?—Never. On the only occasion on which I sounded the depth of one of those cracks the weight dropped down 14 feet, and did not reach water then. (This was on the outward journey.)

1289. (*Admiral Inglefield.*) Did you carry lime juice with you as a part of your equipment for the sledge journey?—No.

1290. Did you recognise the symptoms of scurvy amongst your crew, and at what time?—On the 30th of April the first symptoms appeared, but were not recognised as scurvy.

1291. Had you instructions from the medical officers of the ship to guide you as to the treatment?—We were ordered to use scurvy-grass and sorrel if we had an opportunity of getting it.

1292. Did you find any scurvy-grass or sorrel?—No.

1293. Had you no lime juice amongst the medical comforts for the sick?—There were no medical comforts supplied to the sledge equipment.

1294. Can you suggest any alterations in the equipment of a sledge, or better cooking apparatus than those which you carried?—With the exception of a few minor fittings in connection with the cooking apparatus, such as the alteration in the thread of the screw of the spirit lamp, and handles on the kettle, I know of none; and those are mentioned in my sledge journal.

1295. You mentioned in your dog-journey the great advantage of compressed tea, describe what those advantages are over the ordinary tea, and how was it carried?—Compressed tea is made up in little cakes of half an ounce each, which is the daily allowance for each man. The advantages, therefore, are the ease with which the actual allowance can be issued on a sledge journey without measurement, and that, in the opinion of my sledge crew and myself, three quarters of the allowance was fully equal to the full allowance of ordinary service tea. It was owing to this that we always had surplus tea on the sledge, so as to enable me to save a fourth of the allowance each day.

1296. I see you state that the men gave a decided preference to tea over rum; is that your opinion?—For the middle of the day, it is my opinion that tea is decidedly preferable over rum, but the delay occasioned by the cooking is serious where you have only one sledge. When you are working double manned, or advancing by half loads, the cooking apparatus can go on with the first trip, and the tea be cooked by the time the second sledge, or load, comes up. In this case the delay is nothing, but with a single sledge it causes a delay of an hour and a

quarter to an hour and a half, and sometimes more in very windy weather.

1297. If you had had lime juice with you, do you think you could have mixed it with your tea and taken it with advantage, seeing that it is customary in some parts of the world to put lemon juice with tea?—If it be proved that lime juice will have the same action in cold weather as in more moderate climates, and that sickness can be prevented by its use, it might be taken perhaps in tea with advantage, as anything is preferable to sickness; but seeing that one pint of tea, and biscuit and bacon half thawed, is the only sustaining food that sledging admits of during a nine or ten hours' march, I think it doubtful whether, until it is proved, it would be advisable.

1298. What quantity of concentrated lime juice would each man's allowance amount to in size?—I am unable to say.

1299. When it is served in a wine-glass, or in a gill measure, what quantity does it amount to?—About two tablespoonfuls a day.

1300. Then one tablespoonfuls at each meal would be the ration per man?—Yes.

1301. Has it occurred to you that lime juice might have been carried in capsules or condensed like your tea, sufficient for each man?—I have heard since I came home the suggestion to carry it in capsules, or even cakes, but I am not aware that those suggestions would be of any value if their practical application was asked for.

1302. We have it in evidence that Captain Markham used to thaw a certain amount of lime juice by taking the bottle inside his bag with him at night, and thus was able to thaw it merely by the heat of his body, and to have quantity enough for two or three patients; under these circumstances, if each man carried a capsule into his bag with him he might then, without the use of fuel, thaw a sufficient quantity for his own use during the day; have you any suggestion to offer with regard to that?—There being no capsules supplied to the expedition, I can hardly say how it would act, but from the fact of having thawed medicines in my bag, at night, and having suffered from the corks coming out of the bottles in my trousers pocket, when carrying eyewash and glycerine for the use of the crews, I would say, in whatever form it may be considered necessary to take lime juice for the future, it must be placed in something which is not easily broken.

1303. Can you give the Committee any information on the subject of the present inquiry, which your experience has suggested, with reference to the method of travelling, the form of sledge, hours of rest, provisions, clothing, or any details, as if you were ordered to undertake a journey to try to reach the pole, and you were cast upon your own resources as to the way in which your sledge should be fitted out, provisioned, and fully equipped, or with reference to the treatment of the men during the winter months, including ventilation of the ship, anything, in fact, which bears upon the subject of the prevention of the outbreak of the scurvy in an arctic expedition?—With reference to provisions in a sledging expedition, I have offered a few suggestions in my sledge journal, and I would say that, where game cannot be depended on, it might be beneficial, taking a small quantity of preserved meat in lieu of pemmican, as a change of diet; but the quantity I should imagine ought to be small, as I do not think there could be any better form of food for the heavy exercise demanded in sledging than that which is given as pemmican. But I found in several cases that the pemmican did not suit some of the men, whether it was because they were out of health or not I am unable to say, but I should think it was, as Ayles and myself, the only two really healthy ones of the party, were able not only to eat our whole allowance of pemmican daily, but more when we could get it. Finding that the pemmican did not agree with the captain of the sledge, before I finally parted with Lieutenant Giffard I wrote to ask Captain Nares to send out a small quantity of preserved meat to the depôt

of provisions which was to be established in my absence, about 70 miles from the ship, for my return journey. He complied with my request, and sent some out, and, notwithstanding that the appetites of the men were at that time miserably small, the whole allowance of weight of preserved meat was eaten directly we got it, every man being able to eat his allowance. The making up into parcels the provisions for a sledge journey cannot be fully entered into and arranged until the exact object and extent of the journey is determined; but any arrangements that can for the future be made in the facilities for measuring off the daily rations of a sledge crew must be very advantageous. The compressed tea is an example of this. Sugar and potatoes, and all those small things, groceries, as we call them, require time in measuring out, and throw extra work on the captain of the sledge. Biscuit being carried in bags, loses somewhat in weight through the dust, but every package that is put on a sledge means extra weight, and therefore, perhaps, nothing better than the bread-bag can be decided on, taking all things into consideration. With regard to the sledge for ordinary travelling, I do not imagine any improvement could be made; but where deep snow has to be encountered, the bearers, perhaps, might be broader, or some means suggested of furnishing them with a plate on the bottom, to give them an increased bearing on the surface of the snow; but whatever those means may be they must be very light, strong, and easy to do away with when ordinary travelling is reached. I have nothing to offer as improvements to the tent or coverlets, or sleeping bags. The waterproof sheet, however, appears very liable to crack, and become damaged when subject to wet and freezing. I have made a suggestion in my sledge journal, with reference to the use of what is called engine room sheet insertion, for this purpose. It is too heavy as it is now, but some material of the kind, if it could be made lighter, would, I think, do better than the present waterproof sheets, as, in experiments with it during the winter, when soaked in water for 24 hours, and exposed to a temperature of -50° , although the water became hard frozen on the surface, the composition itself remained pliable. The dress of the men appears to me exceedingly good, if I except the yarn guernseys and drawers, which wear out very rapidly. Duffle appears to answer its purpose very well, being more pliable than box cloth for travelling; but it has the disadvantage of letting the wind through. Some few of the men were provided privately with fearnought drawers; these seemed to be very good, and were stout enough, not only to last the whole time without wearing out, but also to enable them to do away with the duffle trousers when the warm weather came on, an advantage which cannot be gained by wearing the ordinary service drawers, as, although it may be so-called warm weather, the wind is liable to spring up, and no ordinary drawers would be sufficient for the men. The snow spectacles were very good, except that they were rather shallow, and the tin cases in which they were supplied were not strong enough. With reference to the foot gear, we adopted the plan of flannel wrappers. These were similar to the blanket wrappers, but made of ordinary thin flannel; being supplied with two pairs of these, they were easily thawed and kept soft during the night in the sleeping bag, a comparatively warm and dry flannel was put on next the skin in the morning. The travelling boots we found rather small in the toe, and we improved them, to our thinking, by removing the leather round the toe half way towards the heel, the leather being an ordinary thin strip, to prevent the duck being kicked out. The head gear was quite perfect, the woollen caps given by the ex-Empress of the French performing the necessary duty of protecting the ears closely, which the flaps of the seal-skin cap do not, except they are regularly fitted for you. I do not think that any improvement can be effected in the hours of rest; the lurch after five or five and a half hours' travelling enabling a

sledge party to proceed very well for four to four and a half hours afterwards. From the cooking occupying so long, the extra work which falls on the cook is very great; but I do not see how that can be prevented. His hours of rest are, therefore, shorter than those of the rest of the crew by an hour and a half actually in his bag, but by between three and four hours difference in time between his and the rest of the crew getting into the tent. The cook is changed every morning after breakfast. The new cook cooks the luncheon, and, on camping at night, cooks the supper, and in the morning is turned out about an hour before the rest of the party to cook the breakfast, and his duties are then transferred to the next number, the captain of the sledge and the officer not taking turns. On the captain of the sledge devolves the duty of seeing the rations of provisions accurately weighed out and issued. He is also responsible for the packing of the sledge. I have no suggestions to offer as to the exercise of the men during the winter, except that I think the plan which was adopted, of giving the men some definite work to do in the open air between divisions in the morning and dinner, and after dinner, was preferable to making them walk out on the floe in the darkness, which was the exercise taken by the officers, as I do not consider that blue jackets are good hands at walking without an object, they having less to occupy their minds and thoughts while doing so. The ventilation of the ship in winter quarters must always be a work of great difficulty. The greatest trouble and care were taken in the opening and closing of the different uptakes and downtakes, the whole of that being done under the personal supervision of the captain. In order to do away as much as possible with the ill effects that might arise from the damp caused by the great condensation, men were told off to the especial duty of constantly going round the lower deck to wipe the beams as dry as they could; and the drying room was very carefully looked after, and each man and officer had the use of it in turn without distinction. The temperature of this room was kept up by a small iron stove, and it ranged between 70° and I think 95° . The housing was fitted by the captain's directions, with two trap hatches, one just before the mainmast, and the other just abaft the foremast. These were invariably opened every day and thrown back. I do not think that I have anything more to offer on these points.

1304. What was the lowest temperature that you experienced in your journeys, and what was the highest?—The lowest temperature by my thermometer was -42° , and the highest temperature that I ever recorded was in my tent at the top, when I hung my thermometer on to the ridge rope, and I think it went up to about 81° degrees. The sun was shining at the time, and I merely did it to see what the temperature of the tent was; but below where we were lying it was about 56° .

1305. (*Dr. Fraser.*) I think you have said that you had three expeditions in the autumn of 1875?—Yes.

1306. Can you give me the date on which you started on each expedition?—The first journey was on the 5th September; the next was on the 9th, returning on the 13th; and the next was on the 22nd, returning on the 5th October.

1307. That on the 5th of September was a mere exploration of a few miles, was it not?—Yes. I think we went about eight or ten miles out.

1308. Not a sledge journey?—No. I only gave that as being in the early part of the time. When we were there, both Peterson and Frederick were with us, and they did some running.

1309. That on the 9th of September was also a short journey?—It was about 25 miles out, depositing a depôt.

1310. How many days were you absent on the journey of the 9th September?—Four days and a-half.

1311. The longest of these expeditions was on the 22nd of September?—Yes; when I was absent about a fortnight.

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1312. Had you dog-sledges on the 9th of September as well as on the 22nd, or how did you travel?—They were dog-sledges in all the three expeditions in the autumn.

1313. How many days were you absent in the expedition of the 22nd of September?—Fourteen.

1314. And how many sledges and men?—Two sledges and three men.

1315. Can you tell us how many miles you travelled per diem throughout the journey on an average?—I do not remember.

1316. Can you give the Committee any printed or written statement of the dietary which you used in these autumn journeys?—I have none with me, but I will furnish it. The only difference between the provisions we used in the autumn and those used in the spring was, that preserved meat was used instead of pemmican, and we had no bacon extra, preserved meat being taken instead, only in my own sledges; not in Captain Markham's sledge.

1317. How much preserved meat?—One pound per diem per man.

1318. Was the amount of work which was done by yourself and the three men who accompanied you in this expedition at all harassing?—It was exceedingly harassing on the return journey, from the continuous snow which had fallen for some days, and through the depth of which the dogs were in some places comparatively useless; but the very harassing work was not of long duration, as directly we got on to more moderate travelling the dogs went to their own work again. Dog-sledging in itself is harassing work, from the unequal pace at which they travel, sometimes stopping and requiring great assistance to move the sledge at all, and at others proceeding at a pace which necessitates a run.

1319. The dogs, however, must have lightened the work to some extent, I suppose?—Yes.

1320. During these three expeditions what drinking water were you supplied with?—Melted snow on all occasions but one, when I picked a hole through 11 inches of ice over a lake of fresh water, and used that.

1321. You obtained satisfactory, and so far as you know, good water on all three occasions?—Yes.

1322. I think, judging from your journal, there does not appear to have been any sickness in the longest of those expeditions (that of the 22nd), excepting in the case of one man who was slightly ill, and only very temporarily, is that so?—Yes, there was no sickness. The only peculiarity that I remarked in the autumn sledging was, that both the Esquimaux and the Greenlanders felt the cold a great deal more than we did.

1323. They did not however suffer so far as their health was concerned?—No.

1324. Then how did they suffer?—They suffered from shivering, and we supplemented their clothing with some of our own from the knapsacks. The Esquimaux was travelling in his ordinary travelling dress, made of seal-skin, which became wet and very stiff, and never thoroughly dried the whole journey; we were dressed in our more woollen clothing, and that may account for the difference in feeling.

1325. Can you give us the average day and night temperature during this expedition of the 22nd of September?—I cannot give the average, but the lowest temperature was -5° ; the discomfort arose more from the wet than from the actual temperature recorded.

1326. In April, 1876, you started on a much more important expedition?—Yes.

1327. How many sledges and men were under your command in that expedition?—The whole of the sledge crews, both of the Northern and Western Divisions travelled together from the 3rd of April until the 11th, in order that they might both be benefited by the advice and assistance of Dr. Moss. On the 11th, I separated from the main body, having under my command an eight-man sledge and Lieutenant Giffard with a second eight-man sledge; the total party consisting of fourteen men and two officers. On

the 25th of April I detached Lieutenant Giffard on his journey back to the ship, and from that date until, I think, the 20th of June, I was by myself with seven men.

1328. That was the sledge "Challenger," was it not?—Yes.

1329. On starting on the 3rd of April, what do you estimate the load per man for the crew of the sledge "Challenger" to have been?—When the men were wearing their duffle coats, the weight on the sledge was 242 lbs. per man. When the duffle coats were not being worn, and were put on the sledge, they brought the weight up to 247 lbs. This weight was dragged for six miles the first day, the officers rendering good service at the fore part of the sledge whenever any stoppage occurred. On the second day, it became necessary to double man the sledges, and, with the exception of one journey, I advanced, either by double manning the sledges or by taking on half of the load at a time, until the 30th of April. The weights, therefore, which the men dragged were actually not more than from 120 to 125 lbs. per man for 27 days after leaving the ship, with the exception of two journeys. On the 30th of April, I had 39 days' provisions on the sledge, which, with the constant weights, would be about 1670 lbs. As I was then in the drag-belt myself during that journey, we dragged an average of about 210 lbs. a man. It was at the end of this journey that the first symptom of bad legs appeared, on the 30th of April; but I think it can hardly have been due to the increased weight which the men were dragging, as the labour was infinitely less than even walking through the deep snow which we had previously been travelling in. On reaching that point, I got rid of over 300 lbs. off the sledge, and from that date the weights materially decreased so far as provisions were concerned, although from the gradual accumulation of frost, and perhaps moisture in the sleeping bags and coverlets, the actual decrease in weight was not so rapid as it otherwise would have been. About the 7th of May, I left another depot, which further lightened the sledge. From this I gather that the extreme weight that my party dragged was 242 lbs. for $5\frac{1}{2}$ hours, on the 3rd of April, as they were then wearing their duffle jumpers. The next heaviest weight was about 208 lbs., on the 30th of April; the rest of the work during the time the sledge was heavy being performed either by double manning or advancing by half loads.

1330. What was the diet list constituting the provisions that you carried in this expedition?—The same as that given in by Sir George Nares.

1331. Then you had no preserved meat in this expedition?—None whatever, except 12 lbs. forwarded to Cape Colan at my request.

1332. The sickness of the man Elias Hill, mentioned in your report, began about the 7th of April?—Yes; there were two men sick on the 7th of April. The Sergeant was taken ill in the same way on the same day, and was excused from hauling for two days, and then he recovered sufficiently to allow him to proceed with the sledge party.

1333. Was the illness the same in the case of the two men?—Yes, so far as I could judge. I put it down more to their walking with the weight of the drag-belt across the chest rather than adapting themselves to the work like the blue jackets, who took the strain more on the shoulder. Being both marines, they appeared to march as if they were in line, and I pointed this out to them as often as I possibly could, both during the time before we left the ship, when we were practising, and also after we left the ship, in the hope of breaking them of it.

1334. What were the symptoms that you noticed?—Pain in the chest and difficulty in breathing.

1335. You refer to Color-Sergeant Wood showing signs of weakness; is that what you imply in your previous answer?—I mean by showing signs of weakness, that he did not appear to me to be so thoroughly sturdy as the other men.

1336. You sent Elias Hill back with Dr. Moss to the ship, I think?—Yes.

1337. Did he afterwards develop signs of scurvy, do you know?—I cannot say.

1338. Did Color-Sergeant Wood, who remained with you, I think you mention in your report, exhibit distinct symptoms of scurvy afterwards?—He was the first man who exhibited discolouration in the leg.

1339. That was on the 30th of April?—Yes.

1340. Did he recover perfectly after the first symptoms of this unmistakable scurvy displayed on the 30th of April, or did he continue, as you describe it, exhibiting signs of weakness?—From the 30th April he got slowly but steadily weaker; when I say showing signs of weakness, it is placing him in comparison with the remainder of the party, who were most undoubtedly exceedingly powerful men. Could the actual weights dragged by each individual be determined, I should think that Sergeant Wood was unable to pull to the extent of the others; in that sense I mean he showed signs of weakness, but he made known no complaint or no difficulties until between his first attack and that of the 30th of April; whereas, on the 30th of April, he showed signs of something being wrong in his ankle; on the previous occasions it was in the chest, and to the best of my belief he was not attacked in the chest until some days alter we commenced our return journey.

1341. Then, so far as you noticed, for an interval of 20 days previously to the exhibition of the red patch, he was in good health?—Yes, to all appearance.

1342. I do not know whether you are aware that in scurvy, red patches are not usually the first or earliest symptoms of the disease?—I am not aware of that.

1343. Then, in all probability, previously to the exhibition of this red patch, he must have been suffering from scurvy?—I am not aware of that. He did not give me any reason to suppose that he was ill, but, as I have remarked, I did not consider him so strong as the rest of the party, but not weak enough for me to think it advisable to send him back to the ship.

1344. The next illness you note in this report is that of James Good, who became ill about the 30th of April also, or some days previously, with diarrhœa?—Yes.

1345. Did Good afterwards exhibit unmistakable symptoms of scurvy?—He was from time to time attacked with diarrhœa. About the middle of May he came to me with a very swollen puffy looking knee, which he explained as having arisen from slipping on the snow, and at that time I believed that to be the case, but as he afterwards developed most unmistakable symptoms of scurvy, I have no hesitation in saying that this was merely the commencement of them.

1346. Which was the next of your crew to exhibit any symptoms of scurvy?—The next man to show any symptoms of swollen legs was James Doidge, about the 6th or 7th of May. By this time the Sergeant's leg had nearly resumed its proper colour, but the leg was swollen and very stiff.

1347. I find that, at this date also, nearly all hands exhibited stiffness and swelling of the legs; is that so?—By this time, five men out of the seven were complaining very much of stiff legs. This we had all been led to expect as a natural consequence of sledging, having read of it in sledge journals, and also heard it in lectures on the subject, and turpentine liniment being supplied, it was used by all those men with a view to assisting them in recovering the use of their limbs, but Doidge and Wood were the only two who, on the 7th, exhibited any decidedly swollen limbs, the remainder being stiff without swelling.

1348. You tell us that you had been led to anticipate stiffness and swelling, from lectures which you heard: what lectures do you refer to?—I think most noticeably that delivered by Captain Nares at the Geographical Society, before we left England, and another one by Captain Nares on sledge travelling,

before we started, when he particularly dwelt on all the circumstances which might arise in sledging, as far as possible.

1349. Did this latter lecture include any reference to scurvy?—None whatever.

1350. You told us, I think, that in this lecture he referred to all the accidents that might occur in sledging?—As far as possible. I mean by that, that he went into the detail of the daily routine of shifting travelling according to the position of the sun; night travelling, when it should be adopted, and why; the different kinds of travelling which were then known; the hours of travelling, and the hours of rest; a general description of tenting, and a few hints as to the best way of pitching a tent, and many other little details of that description, which were very useful to the whole of us.

1351. You had no instructions as to the early symptoms of scurvy, had you, before starting on your sledging expeditions?—No.

1352. Although you had so large a proportion of your crew laid up with what was eventually determined to be scurvy, you did not yourself recognise the disease until you commenced your return journey?—No. Up to this time I imagined that it was owing to the stiff legs, which would get better as the sledge was lightened, and would probably be all right before we got back to the ship.

1353. You mentioned, in a previous part of your examination, the weights which would be required to be dragged per man during this journey. In giving those weights, did you take into consideration the number of men who from time to time had become disabled during the journey?—No; it is impossible to estimate the weights which fall to the lot of each man when sickness comes in to such an extent. The men were dragging as long as it was possible for them to do so, and as much as ever lay in their power, in order to lighten the work for the others; but as they became weaker, they must necessarily have pulled less, and of course made it so much heavier work for the more healthy ones. The weight then dragged by the healthy ones may have been considerably beyond those weights which I have hitherto given as the heaviest dragged on the journey, but that was at a time when but little more than the constant weights were on the sledge. The total weight on the sledge, when we were relieved by Lieutenant May, may have been about 800 or 900 lbs., and the only available one for pulling them up to his ordinary strength was Adam Ayles. Mitchell was able to do a good deal if we went very slowly. Good and Doidge were useful in giving their dead weight where a standing pull was concerned, but the party were unable to move the sledge at all without my assistance. The weight actually dragged by Ayles, then, may have been over 300 lbs.

1354. When you first recognised those symptoms to be scurvy, were you in such circumstances that you could by any possibility have adopted any means with which you were acquainted for giving any relief to your party?—No.

1355. You were not near any depôt, were you?—A few days after I recognised the symptoms of scurvy I reached the depôt at Cape Colan. There I found my depôt, which had been deposited in my absence, and amongst other things was a large jar of lime juice, the neck of the jar having been broken; but very little, if any, of the lime juice could have been lost, as the jar was placed in an upright position and the fracture occurred above the liquid. This lime juice, of course, I took care to issue every day, halting for that purpose about midway between commencing the march in the morning and luncheon. The hills and the land were still covered in snow, and would have prevented any satisfactory search for whatever sorrel might be there, even had I not known that the thaw, which sets in with great suddenness, rendered delay very hazardous, by prolonging my journey beyond the 20th of June, the date that I was ordered back to the ship.

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1356. Do you remember the date on which you reached this depôt where you found the lime juice?—I think it was the 12th of June.

1357. I notice from your report that you did reach a depot previously to that date, on the 5th of June?—On my outward journey I deposited two depôts, one at Cape Aldrich and another at Cape Alexandra. I reached these on the 28th or 29th of May and the 5th of June respectively, but those depôts were formed of the ordinary sledge rations.

1358. Before reaching those depôts which you have last named, you were satisfied of the existence of scurvy in your crew?—No; it was about the 6th of June, I think, that the gums first became tender.

1359. What quantity of lime juice did you find at Cape Colan?—I did not measure the exact quantity, but it was one large stone jar covered with wicker work, enough for an eight-man party, I think, for twenty days.

1360. What, do you think, was about the average temperature to which this lime juice had been exposed, since it had been deposited at Cape Colan?—I think it was deposited in the depôt by Lieutenant Giffard about the 19th of May, after which time the thermometer may have gone down to zero. When I found it it was partially thawed, and in the form of very thick sludge.

1361. The jar had been broken, I think you said?—The neck had been broken.

1362. Did you infer that that had been done for some time before you found it?—I inferred that it was broken when storing the depôt.

1363. I see a note on the same page of your report, that after Lieutenant May came to your relief none of your crew were able to drag the ropes except one man, Ayles. Were they all ill of scurvy with that exception?—Yes; for some days previously three of them had been entirely excused from hauling, being only able to come on a few yards at a time, and then halt to take breath; Doidge, Good, Mitchell, and Ayles being still in the drag-ropes, but the two former very often in a fainting condition. I preferred advancing very slowly to putting the men on the sledge, even had we had sufficient strength to do it. By advancing slowly, I mean that all those men were able to advance a few yards at a time and halt for breath. I did not press them in their marching, and by giving them that amount of exercise I hoped to prevent them from going down entirely and utterly.

1364. Did Ayles exhibit symptoms of scurvy afterwards?—Immediately on Lieutenant May's party joining us they stepped out very much faster than we had been previously able to do, and the increased pace and strain brought on him produced a sensation which he described to me as that of a sprain in his ankle. He, however, continued to pull until we got on board ship, suffering acute pain for one day, and on his reaching the ship I think he was in the doctor's hands for two days.

1365. Do you know with what illness?—Yes, with scorbutic symptoms.

1366. I observe that you yourself had some symptoms which might or might not have been those of scurvy. Were they those of scurvy, do you think?—My symptom was that of sprained ankle. There was no sign of swelling, or anything of the kind, and after I had been on board ship two days I felt nothing more of it.

1367. Did you take lime juice on the first opportunity?—I took lime juice directly we reached the depôt on the 12th of June, and I continued my lime juice on board the ship as usual on reaching it.

1368. Under whose medical charge did you yourself and your crew go upon returning to the ship?—I went under nobody's treatment; the remainder were under that of Dr. Colan, assisted by Dr. Moss; they were both there.

1369. Did all the cases of scurvy terminate satisfactorily, or were there any deaths in your crew?—No deaths.

1370. During this journey, with what drinking

water did you supply yourselves?—Snow-water on all occasions, except on reaching Depot Point, within twenty-five miles of the ship, where there were pools of water formed on the land, and we used them, but this only for one day.

1371. I think you have told us that you judged that the amount of work which your crew performed on first starting was not so great as that performed by the crews under the command of Captain Markham?—For the first eight days, I imagine the work to have been very similar; in fact, from two of my men being excused hauling, the weight per man dragged by the remaining twelve of the two parties averaged fully as much, if not more, than that dragged by Captain Markham's party. After the separation from the Northern party, the work which fell to my men was dragging the sledges one at a time uphill for two or three days over troublesome travelling, but double-manned, whereas Commander Markham's party were rather the more heavily weighted, and the travelling was very much worse.

1372. Then if those first cases of illness, to which I have drawn your attention, were really cases of scurvy, the disease did break out as soon in your sledge party as in the parties under the command of Captain Markham?—Sooner. On April 4th, Hill first complained; on the 5th, Sergeant Wood complained.

1373. Did I rightly understand you to state, that you think it impossible to say if lime juice would or would not prevent scurvy?—Yes, since in my journey lime juice was not taken.

1374. You limit that opinion, I presume, to yourself?—Yes.

1375. And your expedition?—I mean it is impossible for me to say it.

1376. As you know it was not tried, it must of necessity be impossible for you to say?—Yes.

1377. But from your present knowledge, and no doubt you have considered the matter carefully since the return of your expedition, do you think it would or would not be of very great importance to carry lime juice as a preventative of scurvy?—I think it advisable to carry anything that may be considered a preventive of scurvy; but it must be borne in mind that, when these things are taken, if their use interferes materially with the length and duration of the journey, and the work done, it must be fully recognised that limitation is necessary.

1378. I understand from an answer given by you to Admiral Collinson, that you do think lime juice useful in temperate climates, although you have doubts of its use in arctic climates; is that so?—My experience in the navy will not admit of my giving any opinion as to the merits or demerits of lime juice. I understand, from people who have made it a careful study, that lime juice is a very good and excellent antiscorbutic. During my career in the service, my only long length of sea voyages were made when stationed in the Pacific, in H.M.S. "Scout," and during the cruise of Her Majesty's ship "Challenger." On those occasions the issue of lime juice has been always made, as far as I know, in compliance with orders on the subject; but, in addition to lime juice, on no occasion were we more than 60 days at sea without reaching a harbour, where we were enabled to purchase fresh vegetables, and fresh meat. Therefore I have no experience of the use of lime juice as the sole agent for preventing scurvy, which is nearly the case in sledging, with the exception of potato, which I think is the only other antiscorbutic taken.

1379. Did you experience any difficulty in making use of the lime juice which you found at the depôt at Cape Colan?—The weather being warmer the lime juice was already thawed, and a delay was occasioned only of sufficient length to thaw the water necessary to drink it with. There was only the weight of the corresponding amount of fuel, which it was necessary to carry to melt the water, and the extra weight of sugar which was taken with it.

1380. (Dr. Donnet.) Would you describe the nature of the snow in your autumn and your spring journeys?

—The snow in the autumn, from being freshly fallen, and not having been exposed to the very low temperatures of the spring, was of a much softer and, if I may say so, fluffy nature; and on the sledge sinking into it, with the sledge bottom pressing hard on the surface, it became clammy, and sometimes caked; so that great masses of snow were forced before the sledge as we dragged it. A similar kind of snow may be met with towards the commencement of the summer, when the thermometer, rising to a temperature of $+32^{\circ}$, or thereabouts, and snow falling, combined with fog, the snow assumes very much the same kind of qualities. In the very cold weather, however, the snow is finer and much more granulated; it is just as soft in places, and at others a crust is formed over the soft snow, which in many cases is just sufficiently strong not to bear you, but to let your foot through into the soft stuff beneath. Such was the travelling which we had until we reached Cape Columbia; every step we took breaking through this crust, and up to the knee, and sometimes deeper; and the crust in some cases was sufficiently thick to prevent you forcing your leg through it horizontally; so that it became necessary to drag each foot out of the identical hole into which it had broken.

1381. Had these difficulties, such as you described, any influence upon the cheerfulness of the men?—Most undoubtedly, the continuous progression by double manning, and advancing by half loads, was, I will not say depressing, but anything but conducive to cheerfulness. It became necessary to travel three miles for each one advanced, in addition to the extra labour involved in packing and unpacking the sledges, and this through snow which it was as hard to walk through as to drag through. In fact, the drag-belt had the effect of steadying one. The men were not depressed.

1382. Do you think that this very great work caused them to overtax their strength?—I have no doubt that, where a difficulty arises, a man necessarily puts forth more strength than he would if there were none. On reaching Cape Columbia we got on to a piece of ice which lasted for about a-half to three-quarters of a mile, with about 4 inches of snow on it. We marched away with the provisions that had hitherto been causing us great difficulty, without any actual strain on the drag-belts at all. We were able to march perfectly upright, without bending our bodies; and instead of going along a mile or rather over in an hour, we were going over three with much less trouble and far greater satisfaction.

1383. At the commencement of these journeys, did you remark any change in the spirits of your men, caused by the difficulties they thus encountered; for in the latter period of your journey you mention in your journal that "their patience and ready obedience were admirable; but, it was to be expected, they were wretchedly low spirited"?—The low spirits were due to illness; a most marked change coming over them as they got ill; but their efforts to do their utmost and assist one another were untiring as ever. It was more from the fact of their dreading unfavourable comparison with their other shipmates, and with those who had gone before us, than for any other reason, as it was a constant theme of conversation in the tent.

1384. Was the spirit of enthusiasm great amongst your men?—Very much so.

1385. Do you think that their spirit enabled them to go through the hard work they encountered?—I have no doubt it assisted them very materially.

1386. In your evidence you mention that the cold experienced by your party in the autumn journey was felt in a greater degree by the Esquimaux and the Greenlander; can you inform me whether these two men had taken the same allowance of food and the like allowance of lime juice with the other men?—Yes, as far as I am aware.

1387. I think you said that the cold experienced by these two men was due to the difference of their dress?—The Esquimaux felt the cold most, and he

was attired in sealskin, the ordinary travelling dress which he had brought with him from Greenland. Petersen was attired in every way like ourselves, and, although feeling the cold rather more than we did, was not nearly so bad as the Esquimaux.

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1388. Do you think that the illnesses of Color-Sergeant Wood and Elias Hill were caused by the combined action of the fatigue and the cold they had undergone?—I think that their illness was more attributable to the way in which they marched when the strain of the drag-belt was brought across the chest, thereby perhaps necessitating greater efforts to get their breath than in the case of blue-jackets where, by bending their body forward, and giving themselves a half twist, they brought the strain of the drag-belt on to their shoulder blades, that on the chest being comparatively nothing.

1389. Do you consider that the difficulty of breathing which you observed in many of your sick men was caused by the belt itself?—No; I do not, as the men invariably pulled on the shoulder; and in addition to that the complaints in the chest were not exhibited in any cases, except those of the marines, for a considerable period afterwards, when the sledge was very light.

1390. I see in your report, that on the 7th of May, turpentine liniment was used by all hands?—Nearly all.

1391. Were all your men at this time more or less affected?—In my report I said, "nearly all hands," the exceptions being Ayles and Mitchell, and I think probably Good.

1392. I understood you to say that you were instructed by the medical officer of your ship to administer scurvy-grass?—Yes.

1393. But that was in the event of your finding it; you say you found none. Were you able to find sorrel, cranberries, or other reputed antiscorbutics on the ground you travelled over?—No; the land was covered with snow during the whole journey, with the exception of the few bare places which I came across on the return journey, and vegetation here was extremely scant, and nothing beyond a very little green moss was found. The whole extent of the bare patch on which I was, was not more than from 30 to 40 yards long. The only other bare places I saw during the journey were the faces of cliffs. On the face of Cape Columbia, on carefully looking about, I got one small specimen of the poppy of the previous year's growth.

1394. In all ships in which you have served, was not lime juice issued to the crew after the ship had been at sea fourteen days. Have you remarked this?—I think I am right in saying that in the "Challenger" the lime juice was commenced four days after we had been at sea, in other ships from ten to fourteen days.

1395. Can you give any reason why the issue of lime juice took place in the "Challenger" four days after your departure?—No, I cannot.

1396. Have you formed any idea of the reasons why lime juice is given to ships, and are you aware that it possesses any especial virtue?—Yes, I have formed an idea from the fact that it is supplied as a known antiscorbutic.

1397. Did you find the lime juice at Cape Colan of great use to your sick men?—I cannot say that I did. It was taken with great pleasure as a change, and also because we knew that it was considered a good thing; but the men did not improve after we reached the dépôt; in fact, they became rapidly weaker. Good and Doidge notably were men who, up to that time, had been fairly able to do a good share of their work. About three days after we left the dépôt they began to get from time to time in a half-fainting condition, and rapidly got worse, until by the time we reached the relief party, nine days after leaving the depot, Doidge was not on the drag-rope at all, and Joseph Good, although there, was so more for the sake of example than anything else.

1398. During these nine days after leaving the

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depot, had you lime juice in sufficient quantity to administer to the men?—Yes, we had the ordinary ration, in fact rather over. The allowance of lime juice I issued was guided by carefully considering the number of days I should be on my journey to the next depôt at View Point, and the quantity of lime juice in the jar. From this I issued regularly between half and three-quarters of a pint of lime juice, which appeared to be stronger than the lime juice which we had been accustomed to during the winter.

1399. Do you think, from this strength, that it contained a larger proportion of lime juice than that which was issued during the winter months?—I do not think it was any weaker.

1400. You have no doubt given much thought to the question of the issue of lime juice in arctic travelling; would you advise this article to be carried in all future sledge parties?—I would advise that, if possible, means should be found that it might be taken, as any precaution cannot but fail to be of benefit to sledge travellers; but as no such means have been hitherto found, it would become a question of shortening the journey, and extra delay and weight caused by carrying the lime juice. Health being a primary object, of course these drawbacks might be submitted to, if found necessary.

1401. In your evidence to the Committee I believe you have given it as your opinion that no change could be made in the dietary of sledge parties. I would call your attention to the article rum, of which half-a-gill is given as the daily allowance issued; did all the men take this allowance, and would you give your personal experience of it, whether it increased your physical strength, enabled you the better to sleep, and produce other effects which you remarked?—I have in my suggestions for the sledging diet referred to the introduction of preserved meat in lieu of pemmican where game cannot be depended on. With reference to rum, all my crew, including myself, drank it, with the exception of Ayles, and in cases of sickness, when I deemed it advisable to stop it. Our custom was, after tenting at night, to have our tea, then the pemmican, and then the allowance of rum. The rum and the tobacco together had, I consider, a most cheering and salutary effect on my sledge crew. Speaking from personal experience, I can only say that after a heavy day's march it is a most satisfactory thing to sit in one's sleeping-bag, with one's head well covered up, and smoke a pipe, and drink one's rum. Only on one occasion did I try rum in the middle of the day; that was on the 18th of May, when from my extreme camp I made a half journey out with a light sledge, in order to get as far as possible, and if possible to build a cairn; and in order to travel as light as I could I left part of the cooking apparatus behind me, and took the bare allowance of rum. After lunch we began our return to the tent, and, notwithstanding that we had a very light sledge, I found that the men suffered inconvenience from the rum, which they hesi-

tated not to say was not so good for working on as the tea. This, of course, may have been from the fact of the men being debilitated, as we hear of other sledge parties using their rum in the middle of the day, and liking it, and doing excellent work on it.

1402. Did you find that Ayles possessed in any respect any advantage over the other men, he being a total abstainer?—He had the benefit of health and strength during the whole journey; but whether it is due to total abstinence or not, I am quite unable to say.

1403. From your personal experience, would you consider the use of spirits necessary in a future sledge party?—Yes.

1404. Was the allowance of half-an-ounce of tea taken in your sledge diet list the tea which is usually served out in the navy, or was it what you have termed "compressed" tea, and what is the difference?—We were furnished at first starting on the spring journey with compressed tea; we used that tea until the 12th of June, when we reached Cape Colan depôt. At that depot we found the service tea, and we used that until we reached the ship.

1405. You expressed an opinion as to the superiority of tea over rum; at the same time you said that the time taken by single sledges for this purpose would cause a delay of one hour and a quarter to one hour and a half; would you not consider this time worth sacrificing, or would you shorten your journeys to give extra time to the making of the tea?—I would always advocate the use of tea in the middle of the day.

1406. (*The Chairman.*) Would snow shoes have been of service in your sledge journeys?—For the officer, Yes. I think it would enable him to get over a great deal more ground where he can be spared from the sledge party; but I do not think snow shoes would be of any use in dragging a sledge. I think, in future sledge parties, it would be as well to take one or two pairs of snow shoes, not only for purposes of exploration, but also in the event of the necessity of communicating between two points.

1407. What description of snow shoes would you recommend?—My experience of snow shoes is not large, but I think the Canadian snow shoe is very good.

1408. Will you furnish the Committee with the following returns of those sledge journeys in which you were in command, in the forms which will be supplied to you by the Secretary: first, a meteorological return; secondly, a return of sledge work; and, third, a return of distance travelled?—Yes. (Appendix 18).

1409. Had you the same journeys to undertake again, would you diminish the length of the day's journey?—In the event of the same symptoms coming out again, I think I would, to a certain extent, lighten the work; but for all healthy men a journey of nine hours and a-half to ten hours is not too much.

The witness withdrew.

COMMANDER ALFRED ARTHUR CHASE PARR, R.N., *examined.*

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1410. (*The Chairman.*) On what day did you join the "Alert"?—On the 15th of April, 1875, the day she was commissioned.

1411. Did you belong to her till she was paid off?—Yes.

1412. Enumerate the sledge journeys in which you were engaged?—I was engaged in the autumn, the first time for four days, taking out the boats; then for twenty-one days laying out the depôt at Cape Joseph Henry; and in the spring for seventy-two days in the journey north.

1413. (*Admiral Sir R. Collinson.*) What kind of sledges was your first journey performed with?—With an eight-man sledge.

1414. Was the second journey of twenty-one days performed with the same?—Yes; I started with a twelve-man, but that broke through the ice, and we had to go back and take an eight-men.

1415. What was the weight dragged on the first journey by each man on the average?—That I am unable to say.

1416. On the second journey, that of twenty-one days, can you give the Committee any idea of what was the weight dragged by them?—Two hundred pounds, I think, within a few pounds.

1417. Did the same men compose the crews on both occasions?—Yes.

1418. Was their health in any way affected?—No, not that I could see.

1419. Had you any frost-bites?—Yes, in the second journey, there were several, but no bad ones, none which necessitated amputation, or anything of that sort.

1420. Were there any symptoms of scurvy?—None whatever.

1421. Was the travelling from the ship to the

depôt, which you laid out in the autumn, better on the autumn journey or on the spring journey?—Very much better in the spring.

1422. You were therefore subjected to greater inconvenience during the autumn journey than you were in the spring journey until you left the shore?—Yes.

1423. On leaving the shore, will you describe to the Committee the difficulties which you had to contend with?—The principal difficulty was caused by the hummocks between the floes over which we passed, and which had in most instances to be levelled with the pick and shovel before the sledges could be taken across. The snow also was deep and soft in places, but not nearly so bad as in the autumn.

1424. Your first knowledge of the men being affected with the scurvy occurred on what date?—The first man broke down about ten days after starting on the Saturday before Easter day, the 15th of April I think it was; but then I was not aware at the time that the symptoms were scorbutic.

1425. Was that on your sledge or Commander Markham's?—In mine; there was one man in each at the same time.

1426. When you reached the furthest point, how many men belonging to your sledge were of no use to you to drag the sledge?—Three.

1427. Was any man obliged to be put on the sledge at that time?—All the three were on the sledge.

1428. Are you speaking of both sledges or your own?—Only of my own.

1429. Was the prostration of the men very sudden?—With two of the men it was sudden, and with the third it was gradual.

1430. What steps did you take to alleviate the distress which had fallen upon you?—At first we used turpentine liniment and bandages; but when we found that that did no good, we discontinued the use of the liniment.

1431. Had you any lime juice?—Two quart bottles of lime juice.

1432. Did you use it?—We used it as soon as we were sure that the symptoms were scorbutic; that was when the gums began to get bad.

1433. Had you any difficulty in using it?—There was great difficulty in thawing it sufficiently, as on all occasions we endeavoured to thaw the whole of it if it was possible.

1434. When did you administer the lime juice; at what hour in the day?—After supper, in the evening. We gave half-a-gill of lime juice, filling up a pint pannikin with water, giving it to the three men who were worst.

1435. How long were you able to continue the ration of lime juice?—For about a week every day, and afterwards every other day for a fortnight.

1436. When you reached the shore did you find any lime juice at the dépôt?—No.

1437. Would you advise lime juice being carried in future expeditions on the sledge journeys?—Yes.

1438. You from your experience think that it should be part of the daily ration?—Yes.

1439. (*Admiral Inglefield.*) Did you receive instructions from the medical officers of your ship as to the symptoms of scurvy and the remedy which should be applied?—No.

1440. Did you suffer yourself from scurvy in your journey to the north?—I had just the first very slight symptoms when I reached the ship.

1441. To what do you attribute the immunity of yourself while every one else was struck down; I mean with regard to habits and constitution?—I have no idea.

1442. But you took the same food, the same rations, allowance of rum, and so forth as the others of the expedition?—Exactly the same.

1443. Had you failed in reaching the ship and thus obtaining succour, what do you consider would have been the fate of those you left behind, remembering the condition in which you left them?—I think

that most probably more than one would have died.

1444. But would the remainder have been able to get home?—They would not have been able to reach the ship without assistance; somebody else would have had to come in and get assistance for the party.

1445. And was there anybody fit to do so besides yourself?—No; other means would have had to be taken. The worst cases would have had to be left, I think; and those who were fit to come on would have had to come on together as quickly as they could.

1446. I think we understood from Captain Markham that there was no lime juice carried on your sledge journey excepting for the use of the sick?—The only lime juice taken was two quart bottles in each sledge.

1447. Which were intended for the use of the sick?—Yes.

1448. Had you no medical comforts or medicines of any description?—We had medicines, but no medical comforts.

1449. Did you recognise the first symptoms of the scurvy when they broke out?—No; the gums gave us the first intimation of it.

1450. Had a doctor been with your party, do you think you would have received much advantage from his assistance, and so have relieved the sufferings of the men?—Yes.

1451. Can you from your present experience suggest any alterations in the equipment of a sledge, or better cooking apparatus?—No. I think all the equipments were good. The improvements that we tried to make in the cooking apparatus were not successful.

1452. During the journey to the north, did you participate with the men in working, and making the roads, and in dragging the sledges, and thus really go through the same exertion that the men did?—During the first part of the journey I participated in the road making the whole time, and before reaching the farthest point joined in the dragging from that time till they reached the ship. In answer to the question asked just now, what cause I would give for my own immunity from scurvy, I would say, not having worked so hard at first.

1453. Then you would consider that it is unadvisable for men, when first starting from a ship, unaccustomed to hard work, to be forced to exert their fullest strength in the early days of travelling?—Yes.

1454. Now, can you impute to that the cause of an outbreak on your sledge journeys, which clearly did not occur so frequently or so severely during the sledge journeys in previous arctic voyages?—No, because we tried in every way to save the men, and not to overwork them on first starting.

1455. Then can you give the Committee any information on the subject of the present inquiry, with reference to the outbreak of scurvy in the recent arctic expedition. I want to know whether you have formed any theory in your own mind as to the outbreak of scurvy, knowing now so much as you do, having read the account of other voyages, and knowing what difference existed between the character of their undertakings and the character of yours?—A short time after reaching the ship I formed the idea that the absence of the sun for such a lengthened period must have had a great effect upon the whole of our constitutions, more so than in previous expeditions, and that that, in a great measure, helped to produce the outbreak.

1456. Then it was clearly more mental than physical?—No, certainly not mental.

1457. But how does the absence of light affect the body physically, further than making you very pale?—That I am unable to say; but I think even the very fact of producing paleness is sufficient to show that it does affect the constitution.

1458. But do you not allude more especially to the depression of spirits than to the actual physical effect?—No, there was no depression of the spirits expe-

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rienced in the slightest degree, as far as my knowledge goes.

1459. Can you inform the Committee what number of days of darkness you experienced more than those who wintered in Sir Edward Belcher's expedition?—No, I cannot.

1460. You have nothing else to attribute the outbreak to than the extended darkness?—And the consequent confinement, and dampness, between decks.

1461. But that would have been the same, perhaps, in each expedition?—It might have been.

1462. Do you think that if lime juice could have been mixed with the tea it would have been a very objectionable introduction to the beverage?—I tried the experiment myself, and the mixture was certainly one of the most unpalatable drinks that I have tasted.

1463. But may not that be the want of habit; because in some parts of the world, for instance, in Havannah, it is customary always to mix lime juice with the tea, and I believe in Russia?—That is what I have understood, and have tried a squeeze of lemon myself in it, and liked it; but putting in lime juice produced a very different result. Two or three drops in tea make it pleasant; but the quantity which would have to be put in to do any good produces the reverse effect.

1464. What was the result of your experience while travelling as to the effect of taking tea in preference to rum?—My experience was, that tea in the middle of the day for lunch, was infinitely preferable to rum.

1465. But are you of opinion that rum might be altogether abandoned for these journeys?—No; certainly not.

1466. And what do you say about the use of tobacco?—With the exception of myself the men hardly smoked at all.

1467. But why; were they not smokers?—Those that were smokers did not care about it when sledging.

1468. But at night, when you made up your tents, did not the men take a pipe?—In the very cold weather, there was difficulty through the pipes getting frozen, and afterwards they did not seem to care about it.

1469. (*Dr. Fraser.*) Did your men not care for tobacco in any form; did they chew it?—One man smoked and chewed, but none of the others chewed, I think.

1470. What was the history of that man who chewed in reference to the outbreak of scurvy?—He complained of his legs, I think on May the 10th, just before we reached our furthest.

1471. Will you give us his name?—George Winstone; but he continued to drag at the sledge till the day I left the party.

1472. He did not suffer so much as many other men?—No, and he recovered almost immediately after reaching the ship.

1473. Now, I understand you to have told the Committee that the main cause of the outbreak of scurvy in this expedition, so far as you can arrive at any conclusion, was the absence of sun-light for a prolonged period. Am I right in that?—That is putting it in rather stronger terms than I should wish.

1474. Then to what extent do you think it was a cause?—The main cause, I should say, was the insufficiency of proper food. I imagine that if a sufficiency of proper food was at hand, scurvy would not break out.

1475. The main cause was the insufficiency of proper food, you think?—Yes.

1476. The quantity was sufficient I think, was it not?—Ample.

1477. Then what do you think was the impropriety of the food?—I do not think there was any impropriety in the food, as far as our knowledge goes at present; but I think that it would be advisable, if

possible, to try if some other articles of food could not be found for use in the arctic regions.

1478. Then why do you assign the main cause to the insufficiency of proper food, if you are unable to say that the food was improper?—Because I believe that the presence of scurvy itself is sufficient evidence that there is a lack of proper food for the human system.

1479. In fact, all experience of scurvy, probably without a single exception, has shown that it has not depended upon over exertion, upon absence of sunlight, upon damp or confinement, but upon insufficiency of proper food; do you agree with that?—Insufficiency of proper food being the primary cause in all cases.

1480. So that absence of sunlight, with proper food, or dampness or confinement, or great exertion, each with proper food, will not be sufficient to cause scurvy; that is what you mean to say?—How absence of sunlight works upon the system of course I do not know, or what to expect from it; but with regard to the others I should not expect to see scurvy caused by them.

1481. You have been asked about this lime juice which was carried by your boat; I understand you carried two bottles in your boat?—Yes.

1482. Two ordinary beer bottles?—Fruit bottles.

1483. How did you protect the bottles from being broken?—They were carefully stowed in the boat, as carefully as we could stow them.

1484. You succeeded in protecting them from being broken?—The neck of one was slightly broken.

1485. This lime juice was carried in order to give it in any case of scurvy, that might occur; is that what we are to understand, or what was the reason why it was carried?—I did not give the orders for it to be carried, those were given by other authority.

1486. You know, however, that it was not used until cases did occur, is not that so?—Certainly.

1487. And its use was restricted to these cases, as I understood?—Undoubtedly, as it was not used before they occurred, most undoubtedly it was restricted to the cases after they did occur.

1488. I want to ask you (very much for my own information) what was the form in which the preserved potatoes were carried during the sledging?—In bags.

1489. Dry?—Dry; they remained perfectly good.

1490. Did you always ensure that the quantity which is mentioned in the diet list was daily given to each man of your party?—The preserved potato was cooked with the pemmican, so that it had to be eaten with the pemmican, and if a man could not eat it of course he did not get the potato.

1491. Some men could not eat the mixture?—"If" he did not, I say; at first starting the full allowance was invariably eaten by everybody, but later, when they began to get ill, they lost their appetites and then they could not eat it.

1492. What kind of pemmican did you carry?—Both plain and sweet.

1493. Was the plain salted, or was either form salted as carried?—It was undoubtedly necessary to add salt to it to make it palatable.

1494. That is in cooking you mean?—In cooking.

1495. But had it been previously salted?—That I cannot say.

1496. Did you, like another expedition I think, carry bacon also?—Yes.

1497. Did any of your men prefer the bacon to the pemmican?—When they became bad and their mouths very sore, the lean of bacon was almost the only thing they could eat.

1498. Did you notice if the pemmican appeared to increase the thirst of your party at all; that you might have seen possibly from the difference produced where bacon was used in preference?—No, I did not see that it produced thirst.

1499. You have been asked about receiving instructions, I think, from the medical officers previously to your starting on the north sledging expedition. Had you had brought under your notice the recommendations and instructions of the Medical Director-

General as to the general hygienic conduct of the expedition?—No.

1500. You did not know of the existence of these recommendations, did you?—I knew there were some papers from the Director-General, but what I did not know.

1501. You were not acquainted with the contents of these instructions?—No.

1502. What kind of drinking water did you obtain in this northern expedition?—We used snow as a rule, and ice when we could be sure of getting it fresh.

1503. Do you know if the drinking water was ever examined; was there any chemical analysis made of it by any of the medical officers?—Not during the sledging, but I believe that corresponding water was frequently analysed on board the ship by the surgeon, Dr. Moss.

1504. Did your appetite ever fail during the expedition?—I was always able to eat my allowance the whole time, but towards the end I had to force myself rather to do so.

1505. You were suffering from some slightly suspicious symptoms towards the end?—I had what the doctors called petechiæ.

1506. Your appetite remained good quite as long as that of any other member of your party?—Longer.

1507. Then you presented an exception, not only in the comparative immunity from scorbutic symptoms, but also in the excellent condition of your appetite, to the generality of your crew?—Yes; then I imagine that the one reacted on the other.

1508. (*Dr. Donnet.*) You mention in your evidence, the absence of the sun as having had an influence in the production of scurvy; was this due to the real absence of the sun, or do you think it was owing to the confinement which necessarily followed upon its absence?—My idea was that the real absence of the sun produced a great effect.

1509. Did the hard work, of which you had ample experience in your own person, assist in producing scurvy?—Undoubtedly.

1510. Do you believe that it was a chief cause of producing this disease, or was it simply an aid?—Simply an aid; certainly not the cause.

1511. Had the cold you experienced any action in the production of this disease?—I should think not.

1512. Did you suffer from snow-blindness?—A little.

1513. Was it blindness, or was it simply inflammation of the eyes?—It was swellings of the cheeks and face generally, producing very great pain, and making the eyes weak, so that you were unable to use them, but not any pain in the eyes.

1514. Did this inability of using the eyes arise from blindness, or from inflammation of the covering of the eye; were your eyes red, inflamed in fact?—I think so, but there was no pain in the eyes themselves. The reason I say I was suffering from snow-blindness is, that the doctor was with us, and he told me it was snow-blindness, but I imagined that snow-blindness

produced great pain in the eye itself, whereas I had no pain whatever in the eye, merely a swelled face, and swelled round the brows, which produced intense pain on turning in, from the change of temperature.

1515. I ask this question, as I perceive from Commander Markham's journal that, in spite of the snow-blindness with which you were affected, you were able to continue work, and breaking through the hummocks, and making the roads?—I had entirely recovered before it became necessary to make a road.

1516. In your evidence you said that you considered that tea was infinitely superior to rum. Would you give the Committee such information as you have gained upon the value of tea, and any experience of its action upon your own system?—I said that tea was infinitely superior to rum for lunch, as, if having to work hard after an allowance of rum, in my personal experience, I felt a reaction which was not pleasant, but always after tea felt better, and more fit for work than previously, and without any reaction.

1517. Did the spirits, which you state to have produced this reaction, disable you from work?—Partially.

1518. Are you able to describe the effects they produced upon you?—For a time one worked better; then they produced weakness for a time, till the effect wore off.

1519. Do you think that spirits should form a part of the ration of a sledge journey?—Yes.

1520. For what reason?—Because after supper in the evening a glass of grog is very comforting, and assists one to get to sleep.

1521. Do you consider lime juice essential for an arctic sledge journey?—Yes; for sledge parties as at present constituted in the regions in which we travelled.

1522. Did you observe any craving for lime juice amongst the men of your party?—When they knew that they had scurvy they were very glad to get it, but it did not produce any craving in the case of one man who merely took it medicinally and did not like it.

1523. (*The Chairman.*) What generally was the depth of the snow in your northern journey across the ice?—Generally, on the floes, the feet and the runners of the sledge just broke through the upper crust for perhaps an inch.

1524. We have had it in evidence that the men were generally up to their knees, and frequently up to their waists?—That would refer to the snow amongst the hummocks in the spring journey, or to the autumn travelling.

1525. In the march which you undertook alone to the ship, and to which the greater part of the northern sledging party were indebted for their safe return, would snow shoes have been of service to you?—Yes, very great.

1526. What description of snow shoe would you recommend?—I have not had sufficient experience of them to be able to give an opinion.

The witness withdrew.

LIEUTENANT GEORGE LE CLERC EGERTON, R.N., *examined.*

1527. (*The Chairman.*) On what day did you join the "Alert"?—On the 15th of April, 1875.

1528. And did you belong to her until she was paid off?—Yes.

1529. Enumerate the sledge journeys in which you were engaged?—In the autumn of 1875 I went away for four days in charge of a five-man sledge, and in the spring of 1876 I went away first in command of the dog-sledge with one man, Petersen, and Lieutenant Rawson accompanying me down to the "Discovery" and back again. The next trip, I had command of the dog-sledge, and I went over, in company with Lieutenant Rawson, to Greenland and back again. Then I took charge of a party of the "Discovery's" men over to Greenland, and came back with the dog-sledge under Lieutenant May.

Then I went away in charge of a party with the dogs for 14 days on an exploring expedition. Then I went out in charge of a sledge party for Commander Markham's relief, and afterwards I went away to bring the boats on board.

1530. (*Admiral Sir R. Collinson.*) How many days were you absent when you went to the "Discovery" and back?—First of all, I started away on March the 12th, and returned to the ship again on the 15th; and then my second start was on the 20th of March, and I reached the "Discovery" on the 25th, and left on the 30th, and reached the "Alert" on the 4th of April.

1531. And then to Greenland, how many days were you absent?—I am not quite certain.

1532. You went twice to Greenland?—Yes.

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1533. Did you go to the same place?—Yes.
1534. Repulse Harbour?—Yes.
1535. Then you were absent for 14 days upon an exploring expedition?—Yes.
1536. Where did you go to?—We went up to the foot of the United States range of mountains.
1537. Inland?—Inland.
1538. And then you went for Commander Markham's relief, and to bring the boats. Were these always with dogs?—No.
1539. Which were with dogs, and which without?—The first trip with dogs was down to the "Discovery" and back. My next trip over to Greenland I went with dogs, and the inland exploring expedition.
1540. On the relief expedition what sledge had you?—An eight-man sledge.
1541. And for the boats?—I had 12 men, an eight-man sledge and a satellite sledge.
1542. In your opinion would the travelling between the "Alert" and the "Discovery," or the travelling between the "Alert" and Repulse Harbour, be the best?—The travelling between the "Alert" and Repulse Harbour was the best, undoubtedly.
1543. Had you any difficulty with the ice foot between the "Alert" and the "Discovery"?—Very great difficulty. There was no regular ice foot, but the land coming very steep down to the water, and the hummocks being pressed up on the land, you simply had to travel between the land and the hummocks, occasioning very frequently having to lower the sledge down on to the floe, leaving the land, and then sometimes having to drag it up again.
1544. Was the ice foot ever vertical then?—Yes.
1545. And what height?—Varying from 5 feet to about 30 feet.
1546. When you went inland had you any difficulty in dragging the sledge?—Yes, on account of the deep snow.
1547. Which in your opinion is preferable, journeying over the land or journeying over the sea?—That depends. If I had a light sledge I would rather have the travelling over the hummocks than through very deep snow.
1548. How many men had you when you went inland?—Two men, and Captain Fielden, and Mr. Mitchell, the paymaster of the "Discovery," accompanied me.
1549. Five all told?—Five all told.
1550. Was the snow very deep?—As we got inland it was very deep indeed.
1551. How deep do you think it was?—It was so deep that we could not get along with an empty sledge with the dogs, the dogs could not get through it.
1552. Had you ever to travel over the land denuded of snow?—Not on that occasion.
1553. Did you fall in with many lakes?—Yes, two or three.
1554. Did you cross them on the sledge?—Yes.
1555. Without difficulty?—Yes, the lakes were not far inland.
1556. (*Admiral Inglefield.*) When you travelled with the dogs did you have an Esquimaux with you, or a Dane?—Yes, on one occasion.
1557. Were you able to drive the sledge and ride upon it as the Esquimaux do?—No, never.
1558. Did you carry a supply of lime juice?—When I went on the exploring trip inland I did, and afterwards.
1559. What quantity did you carry, and of how many did your party consist then?—The party was five, and we carried an ounce of lime juice daily, per man.
1560. And consumed it?—Yes.
1561. Had you instructions from the medical officer in case of an outbreak of scurvy?—No, not in case of an outbreak of scurvy.
1562. Then you received only medical instructions for general use?—Yes, for general use.
1563. What scurvy had you amongst the men in your longest journey?—Our longest journey was only

fourteen days, and the only case of scurvy was Frederic the Esquimaux.

1564. Did he take his lime juice regularly?—Yes, he was very fond of it.

1565. Had he any idea of an antiscorbutic independent of what you administered to him, such as frozen seal's flesh?—No, he never said anything that I know of.

1566. Was his a severe case?—No.

1567. Did you find the equipment of your dog-sledge and cooking apparatus satisfactory?—We found the equipment very satisfactory, but not the cooking apparatus.

1568. In what respect did it fail?—The cooking occupied such a long time.

1569. Can you suggest any improvement in it?—No, with the exception of a few small improvements which we made on board I could not suggest anything else.

1570. When you used the lime juice on your journey, were you obliged to thaw it separately, and did it occupy a much longer time in cooking?—No; I did not take it until May, and then it did not freeze.

1571. (*Dr. Fraser.*) How many excursions had you altogether in the autumn and spring?—One in the autumn, and six in the spring.

1572. And the greater number of these were very short expeditions, I presume?—Very short.

1573. Which was the longest?—My exploring trip inland.

1574. To Greenland, do you mean?—No; not to Greenland; to Grinnell Land.

1575. How long did the expedition to Greenland last?—I do not know.

1576. A shorter time than 14 days?—Yes; about eight days, I think.

1577. It was in the trip to Grinnell Land that you had a case of scurvy, I think you said?—Yes.

1578. Did you start from the "Alert"?—Yes.

1579. With a crew of five, I think you said?—Five, two men and Captain Fielden, and Mr. Mitchell, the paymaster of the "Discovery."

1580. You carried provisions for 14 days, I suppose?—Yes.

1581. Who drew the sledge?—The dogs.

1582. How was the Esquimaux employed?—In charge of the dogs, driving the dogs.

1583. I suppose he had the hardest work of any of the party?—No; we used to ease him off as much as possible.

1584. We have heard from previous witnesses that taking charge of dogs is very hard work?—Yes.

1585. How long had this Esquimaux been previously employed, previously to this expedition I mean?—It was his second trip sledging in the spring.

1586. He had wintered in the "Alert," I suppose?—Yes; he had wintered in the "Alert."

1587. Had he enjoyed good health during the winter?—I believe so.

1588. His diet, however, in winter quarters would be a greater change to him than to the other members of the crew, would it not?—I could not answer that question.

1589. In the expedition in which he accompanied you, did he suffer much from the cold?—No.

1590. Was he clad in the same manner as the other members of your party?—Yes.

1591. Did he take exactly the same food?—Yes; but he had not much appetite.

1592. He had not much appetite from the commencement of your expedition?—Yes.

1593. Do you know if he took the allowance of lime juice which you have mentioned regularly?—Yes; he took it regularly.

1594. From the day on which he started?—Yes.

1595. What was that allowance?—One ounce.

1596. When was that given?—We used to give it generally in the evening, just when we halted, as soon as we could get the water melted; but sometimes we used to get very hot in working, and we would halt in the afternoon and make it then.

1597. The whole quantity was given at one time?
—At one time.

1598. What symptom of illness did you first notice in this man?—His legs became of a blueish reddish colour, much like a bruise.

1599. He had been feeble, I presume, sometime previously?—He did not complain about it at all, but he was never a very strong man.

1600. Did he complain at all of fugitive pains previously to the discolouration?—No.

1601. Had he any change in his gums at any time so far as you know?—No.

1602. Had he any diarrhoea?—No, no diarrhoea.

1603. Was he able to continue his employment all the time?—Nearly so; when we came to a good bit of travelling we used to put him on the sledge.

1604. How long was he ill?—I am not quite certain.

1605. Did he recover before the excursion was over?
—No; he had not recovered then.

1606. (*Dr. Donnet.*) What measures did you take with the Esquimaux in your journey to Grinnell Land, besides carrying him on your sledge when he became affected?—I thought it was simply a bruise, and I used to put some liniment on, and bind his leg up with a bandage.

1607. Did you think it was scurvy at the time?—No, I had no idea that it was scurvy.

1608. Did this man take his allowance of spirits?
—Yes.

1609. Was he fond of it?—No, not particularly.

1610. (*The Chairman.*) Had you snow shoes in your inland journey?—No.

1611. Would they have been of service to you?—Yes, of very great service.

1612. What description of snow shoes?—The ordinary Canadian snow shoes.

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The witness withdrew.

Adjourned to to-morrow at 11 o'clock.

WEDNESDAY, 17TH JANUARY, 1877.

PRESENT:

ADMIRAL SIR JAMES HOPE, G.C.B., in the Chair.

ADMIRAL SIR R. COLLINSON, K.C.B.

VICE-ADMIRAL E. A. INGLEFIELD, C.B., F.R.S.

JAMES J. L. DONNET, Esq., M.D., Inspector-General of Hospitals and Fleets, R.N.

THOMAS R. FRASER, Esq., M.D., F.R.S.E.

H. J. VANSITTART NEALE, Esq., Secretary.

THOMAS COLAN, Esq., M.D., Fleet-Surgeon, R.N., *examined.*

1613. (*The Chairman.*) On what day did you join the "Alert"?—On the 15th of April.

1614. Did you belong to her till she was paid off?
—Yes.

1615. Enumerate any sledge journeys in which you were personally engaged?—None.

1616. Did you furnish any instructions for the use of the officers who were in command of the sledge parties?—Yes.

1617. Will you produce them?—Yes, I will produce them.

1618. (*Dr. Fraser.*) I believe that you passed the winter of 1875 on board the "Alert"?—Yes.

1619. In medical charge?—Yes.

1620. During that winter, had you much sickness among the men under your medical care?—Not much.

1621. What description and amount of sickness had you speaking generally?—The diseases were principally frost-bite and a few cases of catarrh.

1622. What was during that period the number of officers and men under your care on board the "Alert"?—Seventy.

1623. When had you your first death during the expedition?—On the 14th of May, 1876.

1624. And whose case was that?—It was the case of Neil Christian Petersen, Danish, dog driver and interpreter.

1625. When did his illness commence?—His illness commenced away sledging. He was brought back to me on the 15th of March.

1626. He had not been attacked therefore in the winter?—He is not on my list. I do not know that he was attacked by anything.

1627. Then during the winter of 1875 the health of the men under your medical care was satisfactory, in your opinion?—Quite so; it was remarkable. Taking the usual run of the service, it was better during that time than was that of the general run of ships that I have ever had.

1628. That was up to what time?—That was up to the time that I examined the men for the general sledging; in fact, the end of the winter.

1629. You made this examination for the general sledging at what time?—I gave in my report to the Captain on the 24th of March. I was two or three days getting hold of the men.

1630. And up to that time the health of your men was eminently satisfactory?—As a general body of men. I may tell you that there were a few cases who were on the sick list, but it was eminently satisfactory as regards the general body of men.

1631. During this period in which the health was so satisfactory the amount of light enjoyed by the men was only small, I think?—Yes, their best health was during the winter, and for fifty days of that winter we had complete darkness with the exception of the moon. We had twilight at other times for part of the day until it became totally light.

1632. The period of which we are talking includes in fact, the dark season?—Yes.

1633. In reference also to this period, the men were, I think, during the greater part of it, confined to the ship; as a rule is that so?—They had a certain amount of exercising.

1634. But the greater part of the time was spent on board the ship, or in the immediate neighbourhood of the ship?—Yes.

1635. Was the general hygienic condition of the ship to your satisfaction at this time?—We had to make it so.

1636. Did you succeed in making it so?—As well as we could do.

1637. Were you satisfied generally speaking with the amount of cubic space which you were able to allow the officers and men on board the ship?—They had the usual allowance of naval space to sleep in, so that of course I could not say that that is too little, because it is the general allowance for the service;

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but we did make an effort to extend the men's space, and did do so to some extent to give them as much space as we could afford. We extended the lower deck, that is the men's mess deck a little further aft.

1638. When not sleeping and on board, where did the men usually spend their time?—On their own mess deck, which we call the lower or living deck.

1639. What do you estimate to have been the cubic space allowed to the men on the living or lower deck?—I never took the measurement of the cubic space.

1640. Did you take any means of ascertaining whether it was sufficient or not for healthy existence?—Judging of course from my experience of the service as to what was proper for the men, it was my constant endeavour every day to see that they were in the state which I thought was best, and I judged from taking the air in the lower deck from time to time, and testing for carbonic acid in the air. I found that they were living in, as I thought, as good a hygienic state as we could place them in under the circumstances. I do not say in a very good one, but as good as we could place them.

1641. You examined the air occasionally?—Yes, occasionally Dr. Moss, my assistant, took it.

1642. Generally speaking, what result did you obtain from the examination of the air?—It was always under one-half per cent. carbonic acid in the respired air, which air I took when the men were about two hours in bed.

1643. Does that proportion of carbonic acid convey to you the idea of a sufficiently pure atmosphere?—Yes, so far as carbonic acid goes, in a ship's lower deck at the worst time, but that is no test for the organic elements in the air. It would require, to my idea, one per cent. to produce anything that would be detrimental.

1644. Still the proportion of carbonic acid in the air is an indication, as has been proved by elaborate experiment, of the impurity, organic or otherwise, of the atmosphere?—Yes, of course we do have some in the open air, and I believe it is always considered detrimental to health when in any excess in the air.

1645. Is it not the case that the indication from the amount of carbonic acid is rendered more certain by a comparative estimation at the same time of the amount of carbonic acid in the atmosphere outside of the room; that is to say, in the open air?—Yes, that was tested also.

1646. And with what result?—The estimation of carbon di-oxide in the external air gave results not differing widely from the averages of pure air in Europe.

1647. You are reading, I think, from a report which you hold in your hand—would you give a copy of your report to the Committee?—Yes (*delivering in the same*). (Appendix 20).

1648. Do you feel confident that you make no mistake about the statement relative to the quantity of carbonic acid in the atmosphere?—I am going by my assistant, who took the chemical properties of the air.

1649. Does that statement which you have given us refer to the living rooms or the sleeping rooms?—To both; because they sleep in the same place that they mess in.

1650. Will you describe generally the means which were adopted for changing the atmosphere on board the ship, that is to say for the ventilation of the ship?—On leaving England we had no systematic system of ventilation, but when we got into the arctic regions, and the ship was fixed in winter quarters the captain and myself established a system of ventilation which consisted principally in having uptakes and down-takes of stove funnelling in different parts of the ship, and also doorways—we found that the doorways acted to establish a draught between the decks. The seven stoves also acted as uptakes for foul air. I have in my possession a detailed account of our proceedings as regards the ventilation. We found particularly that the stoves having arms of about four

feet from the deck open made very powerful uptakes. Over both hatchways, leading to the upper deck, we established an uptake and down-take of stove funnelling. After a little while this system seemed so perfect in the way of clearing the deck, that no smoke remained on deck from any of the stoves or fires. We had to be very cautious about admitting too much air down, owing to the great cold of the external air, and from day to day as we found out any defect we remedied it.

1651. Had you any means of heating the pure air which entered into the ship?—We had no means whatsoever and no means were adopted. I did recommend a system of that kind, but it was not adopted.

1652. You think, therefore, that it would have been an advantage to have had such a system?—I do.

1653. In the absence of this system, it was difficult, I suppose, to admit as much fresh air as you might have thought necessary, owing to the great cold?—I think we had sufficient air between decks under the system that we adopted; of course more may have been requisite, but I could not state that for certain.

1654. Did you suffer much from moisture between decks?—A great deal in places.

1655. I suppose this moisture was in great measure due to the vapour given off in respiration, and from the skin of the men?—A great deal.

1656. I believe that from 25 to 40 ounces of moisture per diem may in this way be given off by each adult?—Yes, if the urinary organs are in a normal condition that is the case.

1657. Therefore, in order to maintain a pure atmosphere, it is important, is it not, that a sufficient quantity of fresh air should be admitted to hold this moisture in solution as vapour, as well as to remove the carbonic acid and organic impurities generally?—Yes.

1658. Then if you had had means of conveniently effecting the movement of air within the ship more frequently than you were able to do, this moisture might have been diminished in quantity?—Yes.

1659. It did not cause any inconvenience, did it?—I am not aware that it caused any inconvenience; I had no reason to think so at the time, the ventilation and the heat was so much mixed up that it was very difficult to separate the two.

1660. I should like to ask you, in the next place, what was the method of treating and removing excrementitious matter?—We established what we call round houses, or water closets, on the outside of the ship leading from the upper deck, one for the officers, and one for the men. It consisted of a board with holes cut in it, and a snow wall was built round this board, and into this hole the faeces were deposited. This mass was removed from time to time, and a snow wall built up again. Over head a regular room was built to screen us from the cold. The snow wall was below the board.

1661. How frequently was the collected matter removed, do you remember?—I should think about once a fortnight or so. The moment it was deposited it was frozen hard, and the whole lot of it was removed in one solid mass at one time. I am speaking now of the winter.

1662. How was the liquid waste got rid of?—The men also passed water into the snow well just outside the ship's wall; the door led into it from the ship.

1663. You were quite satisfied with those arrangements?—Yes, so far as we could manage in the arctic regions. Of course it would have been more beneficial if we could have had more warmth in the round house, but we had no smell of any kind on the upper deck.

1664. From what source did you obtain the drinking water at that time?—We always obtained our drinking water from the top of a floeberg.

1665. You had no difficulty in obtaining a sufficient quantity?—None on board.

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1666. What was your opinion of the quality?—I had it constantly tested whenever there was the slightest complaint of a salty taste in it. I must tell you that two or three feet of the upper part of the floeberg is fresh, and the other part is salt. When we got as far down as the salt we took care to see that there was no saltiness in the water, and we constantly tested it for saltiness.

1667. Was it tested under your direction by Dr. Moss?—Yes.

1668. With reference to any organic impurity, was the chemical examination generally satisfactory?—Very.

1669. Have you got Dr. Moss's reports in your possession?—No. We are supplied by the service with a water test-box. We merely state to the captain or make a note in our note-book whether it is bad or good. We do not profess to take any estimations.

1670. Can you tell us how the organic matter was estimated in the case of your ship?—I could not tell you unless I had got the report; it was done by Dr. Moss.

1671. Were you satisfied with the arrangements made for victualling at this period on board the ship?—There were little alterations made from time to time on my recommendation to the captain, and also by himself, but as a general rule the victualling was satisfactory according to arctic scales of diet.

1672. The scale of dietary was that which I now give you, I think? (*handing a paper to the witness.*)—I believe it was.

1673. What alterations did you have made in this scale of dietary?—At my representation on the 15th of October, 1875, Captain Nares increased the allowance of preserved meat to one pound, and an additional quarter of a pound of pork was issued every fourth day.

1674. You were satisfied, were you, generally speaking, with the quality of the articles in the diet list supplied to you?—As far as I could judge they were good in themselves, sound and well prepared, with the exception of the beef, which was hard and salt.

1675. Was it on that account that you increased the allowance of the preserved meat?—No; at the time when this was increased the beef was not so bad as it afterwards became.

1676. Then throughout the expedition the quantity of food on board ship, as well as its quality, was in all respects, with this single exception of the salt beef, satisfactory to yourself?—Yes.

1677. The health of the men with this diet was, you have already told us, I think, maintained in a very satisfactory condition?—Yes, very.

1678. Among the rations which were daily issued on board ship, I think there was a quantity of lime-juice?—One ounce per diem per man.

1679. Which was taken by every member of the crew?—Yes.

1680. This issue of lime-juice was afterwards I understand increased in quantity—at what time was that increase made?—It was increased about a month before the men went sledging.

1681. That is to say in the month of March?—Yes.

1682. Why was it then increased?—I do not know.

1683. Were you not consulted upon the matter?—No.

1684. Are you not usually consulted in the service when any important modifications in diet are contemplated?—In the general service, there being a stated scale of diet given to all the ships in the navy, I, as a surgeon, have seldom been consulted.

1685. Is the general scale that you refer to the same as the scale used on board the "Alert"?—Unless I compare the two I could not tell you, and I have not compared them.

1686. You made no objection, did you, to the increase in the quantity of lime juice?—None.

1687. You had an opportunity of expressing an opinion on the subject, had you?—I had plenty of opportunity if any opinion was required from me; the opportunity of speaking to the Captain of course is always open.

1688. In this period up till the spring of 1876 you had one death, I think you have told us?—It was in the summer I had a death.

1689. The case, however, originated in the winter or towards the commencement of spring?—Yes, in fact it was the beginning of spring.

1690. Was this man confined for a long time on board ship?—Very long.

1691. Did you notice anything to lead you to suspect the addition of scorbutic symptoms to those of frostbite in the case of this man Petersen?—Yes, a good while after he became ill.

1692. He became ill in March, I think?—March the 13th or 14th.

1693. What symptoms did you observe, and when, leading you to suspect a scorbutic taint?—Sometime in April he had swelling of the gums.

1694. Between the 14th of March and this time in April, what was the treatment of this man in respect to the administration of medicines or remedies, as well as in respect to the diet which he consumed?—I watched him most carefully myself, and always gave him a dietary at the time that I thought was useful for him. He sometimes had the ship's diet, and sometimes had any medical comfort that I thought he would like, such as preserved fowl, arrowroot, extract of mutton, sago, milk, potatoes, and pickles; and also he required very little medicine, my whole object being to keep up his strength, for which he had port wine, beer, and, in fact, every little comfort that I could give him he had from time to time as he required it. He wanted for nothing in the way of food, except the want of fresh food. I felt very much the want of fresh meat for him.

1695. Had his appetite failed in March to any extent?—I could not say that his appetite failed, except perhaps for a day at a time.

1696. What vegetables did he get in March?—Cabbage, carrots, compressed vegetables, onions, and soft bread, if you might call that a vegetable.

1697. How was the cabbage preserved?—It was compressed dried cabbage.

1698. And the carrots?—The carrots were simply boiled, and in that state kept air-tight in tin cans, the same as the meat.

1699. How were the onions kept?—In tin cans, the same as the carrots.

1700. Did you continue the administration of lime juice to Petersen after the commencement of his frostbite?—Yes, always.

1701. He had lime juice until the scorbutic symptoms manifested themselves?—Yes.

1702. In what quantities?—He had, first, one ounce, and when the gums got swollen I gave him an extra allowance.

1703. Were you quite satisfied with the quality of the lime juice?—I was thoroughly satisfied.

1704. About what time, after the confinement of this man in the sick-room, did scorbutic symptoms manifest themselves?—About a month.

1705. Were you at all surprised to find that scorbutic symptoms should manifest themselves in a patient suffering from frostbite, confined between decks, and supplied with such a dietary as we have been discussing, in which no fresh vegetables could possibly have a place?—I was not surprised.

1706. In fact, would you say that in such a case lime juice, however carefully administered, could not be expected with certainty to act as a preventative to scurvy?—Owing to the circumstances which the man was placed in, I am inclined to believe that more than one ounce of lime juice would be requisite to prevent the occurrence of scurvy.

1707. He had only one ounce?—For a time.

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1708. Did you have the same opinion then as you have now, as to the necessity for a larger dose of lime juice?—No.

1709. You had, I think, no more serious sickness until the spring of 1876?—Not what you would call really serious. We had one man, our ward room steward, who was unwell for some time.

1710. What was the matter with him, and what was his name?—George Kemish was his name. I see that his illness was debility and indigestion. He was a man who had once or twice been somewhat ill during the winter. He was the heaviest case that I had through the winter.

1711. How long was he on the sick-list?—He was forty days.

1712. When did his sickness commence?—On January the 8th.

1713. He came under your care, you say, suffering from debility in the first instance?—Yes, he was a man who drank a good deal, and he came on my list early in January from debility and weakness, induced, as I considered, by drinking too much spirits.

1714. On board ship?—Yes.

1715. Had he symptoms of scorbutus at this time?—I could not detect them, but he had some symptoms which apparently were scorbutic; but I could not state what they were.

1716. What symptoms?—Debility, which I think was induced by drink, and he had some pains about his legs.

1717. Flying pains?—Yes.

1718. Was this in the dark weather?—Yes, during the dark.

1719. You could not judge of the colour of his complexion at that time?—It was very pale; he naturally was a pale man.

1720. Then the suspicion of scurvy occurred to you some little time after he came under your care; is that so?—I could not call his symptoms scurvy; if I did do so, I should have put it down as scurvy, but I gave him extra lime-juice for fear it might be scurvy.

1721. From the commencement?—No, when I thought it might possibly be that he had any tendency to scurvy, he had his own regular ounce once a-day.

1722. When did you think he might have something scorbutic the matter with him?—Towards the end of his illness.

1723. And then you increased the quantity of lime juice?—Yes.

1724. And he recovered satisfactorily?—He got quite well.

1725. Were his gums ever affected, so far as you remember?—I cannot remember.

1726. Were there any discolourations of the skin?—I cannot remember.

1727. What was the moral character of this man so far as you knew?—He was a man who in the opinion of the officers did get hold of the officers' wine and drink it.

1728. Had you seen evidence of excessive drinking in connection with this man for a considerable time before his illness, or only for a short time?—I had seen him the worse for liquor, but not frequently.

1729. During March you were busily employed in examining the men of the "Alert" with a view to their employment in sledging expeditions, were you not?—Yes.

1730. What was the number of the crew of the "Alert" at that time?—Seventy officers and men.

1731. Were they all examined?—All that the captain asked me to examine for sledging work.

1732. How many did Sir George Nares ask you to examine for sledging work?—I cannot tell the number now, but the paper is here. (Appendix 13).

1733. Had you occasion to report unfavourably

respecting any of the men whom you examined for the purpose of sledging?—It appears in the report to which I have referred to.

1734. Looking at the report to which you have referred me, in the first group I see you reported a man whom it would not be advisable to send upon an extended sledge journey?—Yes.

1735. Was your recommendation adopted?—No.

1736. Why?—I don't know.

1737. In the second group you make a similar recommendation respecting one man, was that recommendation adopted?—Yes; he was not sent then.

1738. In the fifth group you make a similar recommendation with reference to one man, was that recommendation adopted?—Yes.

1739. In the sixth group you make similar recommendations with reference to two men, were they adopted?—Yes, both.

1740. The men who were examined by you are named in this appendix, and included within the seven groups which are noted there?—Yes.

1741. And with the exceptions to which you have referred all of those men were employed in sledging?—Yes.

1742. And does this include the total number of men belonging to the "Alert" who were employed in sledging?—Only on the advanced sledges. The other men went away in the minor sledges afterwards, and were all examined before also, but not at this particular moment. Those were the grand sledging parties that were sent out, and there were some minor sledging parties sent out afterwards that I examined the men for, and found them generally healthy. I cannot think at the moment of any exception.

1743. When did the spring sledges start?—On the third of April—these sledges referred to in the report.

1744. Were you consulted respecting the equipment of the sledges?—No.

1745. Are you aware that a different dietary was adopted for the sledge parties from that which had been in use on board ship?—Yes.

1746. Was this dietary brought under your notice?—It was never brought under my notice, but I found it out for myself.

1747. Before the sledge parties started or when, did you find it out for yourself?—About the time that they started, and in fact I knew all through generally what the sledging diet would be, from my reading and talking to my messmates, the captain and others.

1748. But not from any official communication?—None.

1749. Were you ever invited to express any opinion respecting the dietary before the starting of the sledge parties?—No.

1750. If you had expressed any opinion, it would have been an entirely voluntary expression on your part?—Quite so.

1751. Were you aware that the dietary amongst other respects differed from that on board ship in the entire absence from it of lime juice?—Yes.

1752. You found that out for yourself?—Yes.

1753. Was your opinion ever asked as to the propriety of excluding lime juice from this dietary?—No.

1754. You were never invited to express an opinion upon the subject?—Never.

1755. Did you ever express an opinion upon the subject?—Yes.

1756. When and what?—After I understood that lime juice was not to be sent with the spring sledge parties I deemed it right and prudent, if not incumbent upon me, to speak to Captain Nares upon the subject of sending it. I did so in his cabin, and was informed by him to the effect that the lime juice could not be sent unless other things most essential to sledging, were left out.

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1757. Did you discuss the matter any further?—No further.

1758. You understood in fact, that his mind was made up on the matter?—He told me that he could not send it; not that he would not, but that he could not.

1759. Did you inform him of any reason why you thought it was prudent to send it?—No, I did not. I understood from the general conversation, that he understood of course that it would be advisable to send it if possible.

1760. Was the equipment already arranged before this conversation to which you have referred?—The diet list was, I think.

1761. What is your own opinion as to the importance of including lime juice in a dietary such as that for the sledging parties?—I think it would be most useful.

1762. Have you considered the subject specially in connection with this dietary, and have you been able to discover any means whereby it might have been possible to have included lime juice in the equipment of the sledging parties?—Having ascertained that the objection was its weight, and that of the fuel required to melt it, and that the sledgers were so heavily laden that Captain Nares had informed me that he could not send it unless other things most essential for sledging were left out, I did not think of any other means whereby it could be sent, unless Captain Nares had removed some of the sledging gear and reduced the number of days travelling.

1763. Will you kindly tell the Committee what lime juice is?—So far as I am aware, lime juice is procured from the lime at Montserrat, in the West Indies, and is sent home to England in puncheons. The lime juice supplied to the "Alert" and the "Discovery" was obtained from Messrs. Evans and Sons, of Liverpool, and was delivered into the Deptford Victualling Yard, and examined by a board of officers there, for the navy in general. It was packed in jars, wickered to the nozzle, each containing four gallons, or 40 lbs., securely corked, sealed, and capsuled. It was fortified when drawn off into the jars, which was done in April, 1875, by 10 per cent. of the best strong Demerara rum placed in each jar, the jars being then filled up with lime juice. This lime juice was supplied to me from the ship's stores as I required it.

1764. Did you have any opportunity of examining it?—I have never examined it, except by its effects, which I always found good. One jar tasted a little musty, and I recommended it not to be used at the time.

1765. Would you describe the appearance of the lime juice?—It was the colour of dark brandy, quite clear.

1766. No sediment to any extent?—None whatever that I could detect, and the taste was a good strong acid taste without any sourness.

1767. Will you tell the Committee if it is the case that this lime juice contains citric, malic, and tartaric acids, amongst other constituents?—Of course, never having examined it chemically, I cannot say what acids were in it; but from all my reading those three acids are in lime juice, there being a doubt about tartaric acid in some cases.

1768. Is the opinion sometimes held that these acids really constitute the antiscorbutic principles of the lime juice?—Yes.

1769. You are, I dare say aware, that Dr. Trotter and Sir William Burnett and other observers have experimented on a somewhat large scale in order to determine this question, with, on the whole, favorable results?—Yes, I am.

1770. Is it the case that these acids constitute above one-twelfth part of the weight of the lime juice?—It is stated so.

1771. Do you think the evidence to which I have referred in favor of these acids being the possible antiscorbutic principles in lime juice warrants further

trial with the object of establishing this point?—Yes.

1772. In conditions such as those which you have described, connected with the equipment of the sledging parties, do you think it might have been possible, in the event of its having been impossible to carry lime juice, to have carried citric acid, or a mixture of citric, malic, and tartaric acids in place of lime juice, the weight of this combination in quantity equivalent to that of lime juice being only one-twelfth?—Where you could not carry lime juice, it would be possible in some cases to carry these on account of their lightness.

1773. Do you think the facts which have been ascertained in reference to these acid principles would have warranted the carrying of these acids in place of lime juice in the sledging parties of the "Alert," in the event of lime juice itself not having been able to have been carried?—If fuel could be sent to melt water to give those acids in, they would be good substitutes for lime juice in sledge travelling, in my opinion. I cannot speak from experience.

1774. Besides these acid principles are there any other important ingredients so far as our knowledge has taught us in lime juice?—Yes, there is the extractive matter, mucilage, &c.

1775. The great bulk of the weight, however, consists of water, does it not?—Yes.

1776. By driving off the water a concentrated lime juice could be obtained, possessing, in all probability, the active properties of the ordinary expressed juice, could it not?—I am not chemist enough to know that it would remain the same.

1777. If it did remain the same it would, no doubt, be an advantage, so far as carriage is concerned, to get rid of the water?—Certainly.

1778. In what other important respects did the diet of the sledging parties differ from that on board ship?—It was totally different.

1779. What is your general opinion of this diet list, putting aside altogether the question of the lime juice?—I think it very good, speaking from no experience of my own, but from my general observation as a medical officer.

1780. Do you think it is a sufficient scale of dietary to maintain the strength of men undergoing great physical exertion?—Yes, I think that if fully consumed it was a good diet for hard-working men.

1781. What kind of pemmican was carried?—So far as I could ascertain our pemmican was made from the best Aberdeen beef, and was prepared at the Deptford Victualling Yard.

1782. There is more than one kind of pemmican, is there not?—Yes, two kinds—sweet and plain.

1783. Which kind was carried, or were both carried?—I think the plain was generally used.

1784. Can you tell us generally how the plain is prepared?—Yes, the beef is cut into thin slices about three-eighths of an inch thick, and the fat and coarse fibre being removed, slices are laid on oak sawdust to receive the moisture. This sawdust being spread on a floor heated from below, the meat is dried slowly for 24 hours, the heat being so moderated as to expel the water, amounting to about 70 per cent., but not to draw out the gravy of the meat. The dried slices are then ground between mill stones, and the powdered meat is mixed with melted and clarified suet of the best quality. The following are the proportions of plain pemmican:—Powdered beef, 4 lbs.; suet, 4 lbs.; Cayenne pepper, $\frac{1}{8}$ of an ounce. This constitutes plain pemmican. To make sweet pemmican: half-a-pound of sugar is added. The mixture is then put in tins of 14, 16, 28, 32, and 56 lbs. respectively, and rammed well down with a stick. Lastly some melted suet is poured in and the tin closed up. There may be different ways of preparing it, but so far as I could ascertain that was the method.

1785. So far as you know that was the process

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which was followed in preparing the pemmican which was supplied to the expedition?—Yes.

1786. Did you ever hear if either form of pemmican had a tendency to produce thirst?—No, I never heard that it did tend to produce thirst.

1787. In what form was the potato mentioned in the same diet list supplied?—The potato supplied was Edwards's prepared potato.

1788. How is that preserved?—It is heated and granulated.

1789. In what form does it occur?—It is preserved in tins as a granulated powder.

1790. What treatment has it to undergo before it is ready for consumption?—A slight boiling.

1791. Was it generally liked by the crews?—It was, by the men in general, in preference to all the other vegetables supplied us.

1792. What is your opinion as to the advisability of carrying rum in the quantity represented in the diet table?—The opinion expressed to me by the men who partook of the half-a-gill, was that they enjoyed it very much when going to bed at night.

1793. Did you ascertain if it was otherwise at all beneficial?—They said it cheered their spirits, and in that way was supposed to be beneficial.

1794. You talk on the supposition that it was used only at night?—It was only used at night, that is to say, when the men were going to bed. They often went to bed in the daytime, of course.

1795. When did the first case of sickness after the starting of the sledging expeditions come under your notice?—Our ship's steward came on the list with contusion of the thigh, on the 8th of April, from lifting a heavy cask of provisions which he rested above his knee caps for some time, and which caused much swelling for a time.

1796. That was not a case of scurvy?—Not then; this man did get scurvy afterwards.

1797. What was his name?—George Burroughs.

1798. Did he get scurvy in the course of this illness to which you refer?—Yes. This was a man who got scurvy on board the ship; he had not been sledging.

1799. Had he been examined by you, in reference to the sledging expedition, previously to this?—He had been examined every month, but not for sledging; he was not ordered away sledging by the captain.

1800. He had been examined by you every month, with what result?—Generally good health. I think he had some slight affection of the heart.

1801. Was that all?—Yes.

1802. What was the character of this man?—He was a man who was allowed to act as a sick berth attendant, and was generally attentive and civil; but I think he took too much spirits at times. He was a very honest man, as far as I know.

1803. Why did you think he took a little too much spirits at times?—I thought from his manner that he had been taking them.

1804. Had he any opportunities to get spirits?—I would not undertake to say.

1805. Was he a strong man?—A very powerful man.

1806. Was he addicted to a somewhat immoderate use of spirits, which was in any way prejudicial to his health, so far as you could say?—I could not say he took it immoderately, but if he persisted in taking the quantity I suspected him of taking, it would be injurious to him.

1807. What quantity did you suspect him to have taken?—Somewhat over his allowance; I could not say how much.

1808. His allowance being what?—The allowance being half-a-gill of rum twice a day, except on the beer days, when he had only one allowance of rum.

1809. He was a man of good health, you say?—He had an affection of the heart, but he was a very powerful man.

1810. Were you acquainted with his previous history?—Yes, medically.

1811. Was it to your entire satisfaction?—Yes, up to the time of entering.

1812. When was he examined except immediately previously to April by yourself or by your assistant?—I saw him every day, but he was examined by me monthly with the other men.

1813. On what date was this monthly examination?—On the 1st of each month.

1814. Had he been quite well between the 1st and the 8th of April?—As far as I know, quite well.

1815. After coming under your care on the 8th of April, when did you first suspect scorbutic symptoms?—I had no doubt of it on the 1st of May.

1816. That is to say 22 days after being placed on the sick list?—Yes.

1817. Was he on the sick list during the entire period of 22 days from the 8th of April?—Yes.

1818. Confined on board ship?—Yes, confined on board ship.

1819. Without any exercise?—Yes, without going outside.

1820. On a sick diet or an ordinary diet?—A mixture of both. As I thought necessary, I gave him medical comforts.

1821. That is to say medical diet?—Yes.

1822. And with what medicines chiefly was he then treated?—He got very little medicine indeed.

1823. The treatment consisting chiefly of external applications?—Yes.

1824. Was his allowance of lime juice continued all the time?—Yes.

1825. Was it increased at any time previous to the 1st of May?—Yes, when I suspected anything like scurvy.

1826. On the 7th of April he was already on a double allowance of lime juice was he not?—He was with the other men.

1827. And this double allowance was continued from the 8th of April until the 1st of May, I think I understand you to tell us?—No, he was on the single allowance.

1828. From what date?—From the time I think that the sledges left the ship.

1829. That was the 3rd of April was it not?—Yes—I cannot be quite accurate as to dates—I am speaking to the best of my opinion and belief.

1830. After the 1st of May, however, did you consider it necessary again to increase the allowance of lime juice?—Before the 1st of May, when I suspected that this might be coming on, a couple of days—I mentioned in my last answer that I felt sure of it on the 1st of May, but I suspected it for a couple of days before hand, and put him on an extra allowance of lime juice.

1831. That is to say on the 28th or 29th of April?—Two or three days before; I was always on the watch for anything of that sort, and even before the thing was developed I tried to meet it.

1832. You, I dare say, were naturally on the watch, having a patient confined in the conditions that you have described in reference to this man?—I was always on the watch for any changes in the men of any kind if they were detrimental.

1833. And I dare say more especially in the case of a man suffering from an existing illness?—Yes.

1834. Such suffering being in itself a very probable predisposing cause of scurvy?—Yes.

1835. And the special conditions necessary for the treatment of such a case, I refer to the confinement in a sick room on board ship, being also of necessity predisposing causes of scurvy?—Yes.

1836. After the 8th of April what vegetable articles of food had he as a rule?—He had cabbage, carrots, onions, compressed vegetables, potatoes, pickles.

1837. What symptoms of scurvy did you observe at first?—His gums were swollen.

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1838. You could not judge, could you, of any loss of strength?—Yes, he was debilitated.

1839. How did you judge of that?—He expressed himself to me as very weak.

1840. Was he confined to bed?—He had been for some time with a swollen knee, but used to sit up occasionally, and then used to say that he felt weak.

1841. Quite unfit to follow his usual occupation?—Yes.

1842. Incapacitated also from taking much exercise even on board ship?—Yes, even on board ship.

1843. What was the hygienic condition of the sick room generally in which this man spent his time from the 8th of April?—He had his bed laid down in the issue room, which was about the size of an officer's cabin, a dry room, lighted by a skylight over head, and fairly ventilated as far as the ship would allow. There was also a good amount of provisions in store there for present issue, such as sugar, and things of that kind.

1844. What was the after history of this case?—He was treated for scurvy and got well.

1845. When had you the next case of scurvy?—On the 6th of April, a man named Berrie was sent back by Dr. Moss from No. 4 sledge with debility; though he himself declared he was quite well when he came on board. He had then no symptoms of scurvy whatsoever, save that he was thought unfit for the hard work which he had to undergo as captain of the sledge.

1846. What was your opinion of his case when you first saw him?—My opinion was that he was unable to do his work according as it was said of him; but he appeared to me well.

1847. Is debility an almost invariably early symptom of scurvy?—Not invariably by any means from my experience.

1848. What have you found to be among the earliest symptoms?—It depends upon whether the man has been sledging or not.

1849. Let us take in the first instance the case of men who have been sledging; what in your experience has been the earliest symptom generally speaking?—Pains in the legs and stiffness.

1850. And in other cases?—On board ship generally the gums first.

1851. Did this man Berrie recover?—I did not place him upon the sick list for two or three days, and then I did place him on for debility.

1852. What was his after history?—He was discharged to light duty on the 1st of May, but his gums were slightly swelled.

1853. Do you say that he was discharged for light duty with the unmistakeable evidence of there then being scurvy?—No, we had so few people on board at the time to perform duty, the others being sledging, that we thought he would get no harm by a little light work, which he would have to do in the open air, and going about a little and having really no work to do but to keep his eye on different things in the ship—indeed it was considered beneficial for him to knock about a little in that way. For a fortnight he was doing a little light duty, and then symptoms of scurvy did develop themselves more strongly.

1854. Had he ever entirely recovered his health between the 6th of April and the 1st of May?—Never from the time he came in to me; but he did recover. I put him down as from the 13th of April to the time he was discharged duty altogether as a case of scurvy.

1855. Which was your next case?—The next case was Vincent Dominique, April the 9th, who came back with a rather severe frost-bite from the sledge.

1856. What sledging party did he return from?—I cannot now call to mind which sledge party he was with.

1857. What was his after history?—This man was

placed on the sick list with scurvy on the 25th of April.

1858. Which was your next case?—On the 28th of April, John Simmons.

1859. Was that a case of scurvy?—Yes, he was placed on the list with scurvy.

1860. Had he been on a sledging party?—Yes, he had been on a dog-sledging party to the "Discovery" and back, and to Greenland across Robeson Channel and back.

1861. Which was your next case?—The next was David Deuchars, ice-quartermaster.

1862. He also returned from a sledging party, did he not?—He had been two sledge journeys to Cape Joseph Henry and back.

1863. What dates were those journeys?—The sledging officers have the dates in their logs. I have not them.

1864. When did he come under your care?—He was put on the sick list on the 1st of May.

1865. What was your opinion of his case when he first came under your observation?—He had *oedema* of both legs.

1866. Your diagnosis was what?—I put him on the list with scurvy.

1867. Did this case recover?—Yes.

1868. Which was your next case?—The next case is that of Burroughs, which you went into before, the ship's steward—when I told you scurvy became developed in him.

1869. The case which appeared to originate on board ship?—Yes.

1870. Which was your next case?—The next case was John Thors, ice-quartermaster.

1871. What date did he come under your care?—He was admitted with scurvy on the 12th of May. He had been two sledge journeys to near Cape Joseph Henry and back.

1872. Had he become ill during the sledge travelling?—There is no report made to that effect.

1873. Was he sent back on account of illness?—No.

1874. You are not aware whether he was ill during that expedition?—I think not.

1875. Whom was that expedition commanded by?—He had been with Dr. Moss on his first sledge journey, and I think the second also.

1876. What symptoms did he exhibit when he came first under your care on the 12th of May?—Tender gums and slight bronchitis.

1877. You do not know how he had been employed on the 11th of May, do you?—No, he was generally employed on board.

1878. Did this man recover?—Yes, quite.

1879. Which was your next case?—Benjamin Wyatt, A.B., was admitted on the 20th of May. He belonged to the "Discovery," and this man had been to Polaris Bay, across the Straits from his own ship and back, and from the "Discovery" to this vessel.

1880. A really continuous journey in three stages, as I understand you?—Yes. He also recovered.

1881. Did he exhibit unmistakeable symptoms of scurvy on coming under your care, and what were they?—Swollen and tender gums and pain in the right thigh.

1882. Was there any discoloration?—None that I remember.

1883. You have none noted?—No.

1884. Did this man recover?—Yes, he recovered.

1885. Which was your next case?—James Caue, armourer, who had been a sledge journey to near Cape Joseph Henry and back.

1886. When did he first come under your care?—On the 20th of May.

1887. Are you aware whether he was taken ill while on this journey?—He was not.

1888. He returned from an expedition unwell?—No, he complained on board afterwards. He had been sledging.

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1889. He came under your care on the 20th of May. What symptoms did he then exhibit?—He exhibited swollen ankles and sore gums.

1890. Any discoloration?—Afterwards.

1891. What was the after history of this man?—He got well.

1892. I observe that this case (James Cane) is one of those with respect to whom you had reported unfavourably on examining the crew?—He was.

1893. In fact you are stated to have reported, "It would be advisable not to send him on an extended journey"?—Yes.

1894. He was sent?—He was sent upon a journey, but not the extended one.

1895. Which was your next case?—On the 24th of May, William Lorimer, A.B.

1896. Do you know how he had been employed immediately previously?—He was brought back by Lieutenant Giffard.

1897. From where?—From a journey in support of Lieutenant Aldrich.

1898. Unmistakeably afflicted with scurvy?—He was admitted with debility and swollen gums, accompanied with rigidity of the ham strings.

1899. Did this man recover?—Yes.

1900. Which is your next case?—William Wolley, on the same day, who had done similar work.

1901. Do you mean on the same expedition?—Yes, he and the previous man had been two sledge journeys.

1902. And what symptoms did he exhibit?—Swollen gums and ankles.

1903. Did he recover?—Yes.

1904. Which is your next case?—Frederick, the Esquimaux, on the 25th of May, who had been employed with the dog-sledge.

1905. What symptoms did he exhibit on coming under your care?—He had a swelling of the left leg and some rigidity.

1906. And what was his history?—He had been away with the dog-sledge.

1907. Where?—I cannot call to mind.

1908. Under whose command?—I think he was always under Lieutenant Egerton.

1909. Did this man recover?—Yes.

1910. Which was your next case?—Robert Symonds.

1911. And what day did he come under your charge?—On the 25th of May.

1912. Exhibiting what symptoms?—He had livid blotches on both legs.

1913. Do you know how he had been employed immediately previously?—Yes; he had been two sledge journeys with Lieutenant Giffard.

1914. Did he recover?—Yes.

1915. Which is your next case?—Thomas Smith, a marine.

1916. When did he come under your care?—On the 30th of May.

1917. Will you tell us the symptoms?—Slightly sore gums, lividity and swelling of the right leg.

1918. And what had been his employment immediately previously?—He had been three sledge journeys to near Cape Joseph Henry and back, and one journey across the channel to Greenland and back.

1919. How had he been employed when the scurvy commenced?—Doing his duty.

1920. And how long had he been on board before symptoms were first observed?—I cannot say. I have not got the sledging journals to know when they came back.

1921. Did this man recover?—Yes.

1922. Which was the next case?—Thomas Chalkley, A.B., of the "Discovery."

1923. When did he come under your care?—He came under my care on the 1st of June.

1924. And what symptoms did he then exhibit?—He had sponginess of the gums, partial lividity of the thighs and legs, with debility.

1925. How had he been employed before coming under your care?—He had been on a sledge journey to near Cape Joseph Henry and back, and to Greenland across the Straits where he travelled for a week with Lieutenant Beaumont to the eastward; then back to Polaris Bay and across the Channel to his own ship, and from there to our ship.

1926. Did he become ill on board ship or while travelling?—He was taken ill while travelling.

1927. Did he recover?—Yes.

1928. What is your next case?—Daniel Girard, A.B., of the "Discovery."

1929. When did he come under your care?—He came under my care on the 20th of June.

1930. And what symptoms did he then exhibit?—Sore gums and slight rigidity of the muscles of the left thigh.

1931. How had he been employed previously?—A sledge journey up Lady Franklin Strait; also across the channel to Polaris Bay, and back to his own ship, and from there to our ship.

1932. Did he become ill on board ship, or while travelling?—On board.

1933. How long had he been on board before showing symptoms of illness?—I cannot tell, not having the sledge journals.

1934. Did he recover?—He recovered.

1935. What is your next case?—My next cases are those of the two travelling parties of Captain Markham and Lieutenant Aldrich: they arrived in groups.

1936. They did not arrive singly?—Two of the men came the day before. They were brought in by a party.

1937. Which two?—John Shirley and John Pearson were sent in the night before.

1938. Will you give the exact date?—The 13th of June.

1939. What symptoms did they then exhibit?—John Pearson, sore gums and rigid hamstrings; and Shirley, debility and depression of spirits, and dyspnoea, sore gums, discolored knees, and rigid hamstrings.

1940. And how had they been employed immediately before?—They were employed in Captain Markham's sledging party.

1941. Did they recover?—Yes.

1942. Which were your next cases?—Edward Lawrence, Thomas Rawlings, Daniel W. Harley, Thomas Jolliffe, John Radmore, George Winstone, William Maskell, Thomas Simpson, William Ferbrache, Alfred Pearce, John Hawkins, and Reuben Francombe.

1943. Eleven cases in all?—Yes.

1944. On what day did these eleven come under your care?—On the 14th of June.

1945. And were they all suffering from scurvy?—Yes, all suffering from scurvy.

1946. From which expedition had they returned?—From Captain Markham's northern expedition.

1947. Do you know if they belonged to the same crew as Shirley and Pearson?—Yes.

1948. Did all these cases recover?—All of them recovered.

1949. Which was your next?—A man named William Ellard, a marine, came on on the 17th of June.

1950. And what symptoms did he exhibit at that date?—Sore gums and rigidity of the muscles of the inside of the thigh.

1951. How had he been employed?—He had been employed with Lieutenant Giffard both journeys, and also with a relief party to near View Point near Cape Joseph Henry.

1952. Did he become ill on board ship, or while travelling?—On board.

1953. How long had he been on board before becoming ill?—Three days.

1954. Had he immediately, on returning, been

again placed on rations of lime juice?—They were always placed on lime juice immediately.

1955. Whether ill or well?—Yes.

1956. Did this man recover?—Yes.

1957. Which was your next case?—The party under Lieutenant Aldrich; on the 25th of June his men returned suffering from scurvy, more or less.

1958. Will you kindly mention the names of that party?—Joseph Good, Adam Ayles, James Doidge, David Mitchell, Henry Mann, Thomas Stubbs, William Wood.

1959. Seven cases in all?—Yes, seven cases.

1960. Did they exhibit undoubted symptoms of scorbutus?—Some of them were milder than others, but all the symptoms were in my opinion scorbutic.

1961. These men constituted a special sledging party, did they not?—Yes.

1962. What sledging party?—A sledging party who rounded Cape Columbia, and proceeded along the land for, I think, 220 miles.

1963. Under whose command?—Under Lieutenant Aldrich's.

1964. Were all these men taken ill while travelling?—Yes.

1965. Did they constitute an entire party?—An entire party, with the exception of the officer.

1966. Did the officer altogether escape?—He said he was quite well.

1967. Had you any opportunity of examining him?—Yes, I examined him.

1968. With what result?—With the result that he was quite well.

1969. Did these men all recover?—Yes, all recovered.

1970. Which was your next case?—Thomas Stuckberry was placed on the sick list.

1971. On what date?—On the 5th of July.

1972. And what symptoms did he then exhibit?—He had slight blotches on the legs, and swollen gums, and rigid ham-strings.

1973. How had he been employed immediately previously?—He had been two sledge journeys with Lieutenant Giffard to beyond Cape Joseph Henry, and with a relief party to near View Point.

1974. Did he become ill while travelling, or on board?—On board.

1975. How long had he been on board before becoming ill?—He had been on board a few days.

1976. But the symptoms you have mentioned are hardly those of the earlier days of scurvy?—No; he complained before he applied to me. Some of the men before they applied to me would naturally have some symptoms.

1977. Then what is your opinion—was he taken ill on board ship or while travelling?—I could not say what symptoms he had while travelling.

1978. But judging from the ordinary history of a case of scurvy, and judging from the symptoms presented on the 5th of July, what is your opinion?—My opinion is that he would have some of those symptoms while travelling.

1979. That the disease, in fact, first occurred to him during his travelling, and not on board ship?—Probably on travelling.

1980. Did this man recover?—Yes; he was but a short time ill.

1981. What is the next case?—That is the last.

1982. These are all the cases of this disease which came under your care?—Yes.

1983. Now, can you tell me what is the total number of cases belonging in the first instance to the "Alert"?—36.

1984. And of the above cases which we have gone into in detail how many belonged to the "Discovery"?—Three.

1985. So that you had under your medical care 39 cases of scurvy?—I had 39 cases of scurvy under my care.

1986. Now, how many of these cases terminated in death?—None that came under my care.

1987. None of these 39 cases do you mean?—One died, but he was not under my care.

1988. What was the general treatment that you pursued?—Dietetic as a rule.

1989. Will you give me some further details as to what you mean by "dietetic as a rule"?—On hearing that the men were ill some distance from the ship, I despatched, with Dr. Moss, medical comforts of different kinds, which proved of great benefit to the sufferers. Those medical comforts consisted of apple jelly, black currant jam, extract of mutton, boiled fowl, milk, arrowroot, calves'-foot jelly, champagne, port wine, egg powder, oysters, and brandy. There was also sent forward from the ship 25 pounds of lime juice and a little fresh mutton that we had hanging up in the rigging, with soft bread.

1990. The dietetic treatment on board ship was the same, I presume?—Yes. In addition to the medical treatment, which involved generally counter-irritation for any effusions into the chest, astringents to stop diarrhoea, citrate of iron, and quinine when the men were recovering, careful dieting was adopted on board. Calves'-foot and apple jelly, jam, marmalade, egg flip, extract of mutton and soup, milk, rice, boiled fowl, vegetables (particularly potatoes), fresh bread, port wine, beer, and sherry were given, while lime juice was administered as freely as I deemed the state of the stomach would admit, or the exigency of the case demanded. The few pounds of English mutton at my disposal were given to the cases most in need of such diet. That was the principal dieting on board.

1991. Did the cases recover tolerably well?—Under this system all the cases recovered.

1992. And quickly in your opinion?—I think so. Cod liver oil was given to two men, one of whom appeared to benefit by it rapidly. The weather throughout July was, on the whole dull and cold; the snow fell at intervals, and the temperature was more than once below freezing point. When the weather did permit, as the men got better they were sent on deck; the bad cases being hoisted up in a cot and laid on deck, all the men being carefully clothed. A good temperature was kept up in the steerage, and great care was taken to use disinfectants, which were rendered necessary from the functions of nature having to be performed on the spot. I am persuaded that the dietetic system adopted proved of the utmost benefit. Fresh food together with lime juice acted almost at once in a favourable direction, and men seldom got any relapse if fresh food could be given them.

1993. The treatment included the exhibition of lime juice?—Yes.

1994. Both on board ship and whenever you had an opportunity of sending lime juice?—Yes.

1995. Did it include any extra issue of vegetables?—I doubled the allowance of potatoes and gave it every day for some time, esteeming that the best anti-scorbutic of the vegetables on board.

1996. While you treated your cases, what doses of lime juice did you find it advisable to administer?—Three ounces generally proved sufficient for the cure of any man, per diem.

1997. I wish to ask you now how many of these thirty-nine cases did not, either immediately or shortly before the occurrence of the illness, engage in travelling expeditions?—Only one did not engage in travelling expeditions.

1998. Who was that?—The ship's steward, George Burroughs.

1999. The man whose case we have already gone into with some detail?—Yes.

2000. What do you attribute this outbreak of scurvy to?—I attribute the remote cause to the absence of fresh vegetable food, and I am inclined to think of fresh meat also. The predisposing causes I could only attribute to the long absence of sunlight,

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the damp between decks which was at times heavy in places, and the cold to which the men were exposed on the floe for the first three months of 1876. The exciting cause was the physical exertion undergone by the men in sledging.

2001. The predisposing causes you believe to be long absence of the sunlight, damp and cold. I imagine that by that you mean that these three conditions somewhat lowered the standard of health, and predisposed to disease, whether scorbutic disease or other disease. Is that your meaning?—My meaning is that the predisposing causes may have rendered the men not so powerful as they were when they left England; but as far as I could judge they were healthy and well when they went sledging.

2002. But the action of the predisposing causes must have taken place before the sledging, that is to say on board ship?—Yes.

2003. Then these predisposing causes which you have named had no obvious effect upon the men?—They had no obvious effect as far as I can judge.

2004. Why do you connect them with the production of the disease in that case?—I only put them down as probable causes predisposing. All diseases, in my opinion, require a predisposing cause.

2005. What do you exactly mean by “a remote cause?”—I mean by that the original cause of the disease.

2006. And what do you mean by an “exciting cause?”—The cause that develops the disease immediately.

2007. You mentioned physical exertion in sledging as the exciting cause; was that exciting cause present in the case, for instance, of George Burroughs?—No; he had a great deal of physical exertion fitting out the sledge, lifting weights, and getting up and running about, and getting the food ready for the sledging party. He had a great deal of labour on board the ship in doing that.

2008. Was that between the 8th and the 28th of April?—No, that was before.

2009. What was his condition, so far as labour was concerned, between the 8th and 28th of April?—He was then on the sick list.

2010. He was perfectly quiescent?—Yes.

2011. Then in his case there could have been no question that physical exertion was not an exciting cause?—It was not.

2012. As thirty-eight of the cases occurred during the travelling in sledges, and only one on board ship, do you think that the difference, which you have already told us was very marked, between the board ship dietary and the sledge party dietary, can in any way account for this marked disproportion in the number of cases?—I do think that it can account for it.

2013. I think you have already told us that the sledge party dietary is one in your opinion well suited for supporting men under great physical exertion. Is it the absence of any nutritious element in this dietary which in your opinion accounts for these cases?—It is the absence of lime juice as a ration to which I would ascribe it.

2014. That is your decided opinion?—To the best of my belief that is the case.

2015. And having that opinion, and taking into consideration the diet list of the sledge parties, can you suggest to the Committee how lime juice might have been taken?—It could only have been taken, as far as I can judge, in small quantities, which would allow of the ration for the sledge party being melted at one time.

2016. Could it have been taken in sufficient quantity by any modification of the dietary that you can think of?—It might have taken the place of sugar.

2017. Do you think that rum is a very important substance to retain in the list?—From what I know of the sledging parties, they would not like the evening issue of rum to be dispensed with, and

therefore I could not say that the rum ought to be omitted.

2018. Had you much opportunity of observing the effects of alcohol on the men during cold?—I had the experience of seeing our men all through the winter who took rum.

2019. Have you arrived at any opinion as to the advantage to be derived from the issue of rum?—I believe its greatest advantage in a cold climate is the temporary cheerfulness which it induces.

2020. Can you inform us if there was any opportunity for making observations on temperature in reference to the effects of alcohol?—No, none.

2021. Do you think that tea or any of the substances allied to tea prove more beneficial than alcohol in cold climates?—I am quite convinced that tea is of much more benefit than alcohol in cold climates.

2022. Can you favour us with a little more detail, and state the grounds for your opinion?—My ground for stating that is that we substituted tea for rum in the luncheons in the travelling parties, and it had a most beneficial effect, according to the men's own statements.

2023. In what way was it beneficial?—To health; they felt vigorous after taking it, and felt no depression after a time.

2024. They were in fact enabled to endure fatigue better than they would have been able with alcohol?—I think that is their opinion.

2025. Have you thought of the question at all of substituting for or adding to the issue of tea any of the allied substances, such as maté or coca?—I have had no experience of those two articles. I can only give my experience of tea itself.

2026. I wish to ask you also if you had any opportunity of occasionally weighing the men under your medical care?—Yes.

2027. And what general result did you obtain?—They generally were increased in weight in the arctic regions.

2028. Will you furnish us with a return of the men you weighed, giving weights and dates?—Yes.

2029. Did the men at any time lose weight?—I cannot say. I think we weighed them twice.

2030. At what dates?—I weighed them at the end of the winter before sledging, and on leaving England.

2031. Were any observations made after the experience of scurvy by any of your colleagues respecting the weights of the men?—I do not think Dr. Moss made any observations.

2032. (*Dr. Donnet.*) In your medical report of Neil Petersen, you state that he was in March severely and terribly frost-bitten in hands and feet, besides which he was suffering from congestion of the lungs. Did you consider this congestion of the lungs a sequence of scurvy?—No.

2033. I put this question for the information of the Committee, as an cedematous state of the lungs has been found in few *post mortem* examinations made of scurvy cases by Doctor Budd when in charge of the “Dreadnought.” You did not consider this as a consequence of scurvy?—No, not at all.

2034. What inspections did you make of the men in the “Alert”; at what time; and did these inspections relate to their general state of health?—Every month I made one relating to their general state of health, on the first of each month.

2035. Were ample means afforded to the crew for the purpose of bathing and general cleanliness, and were these medical inspections always satisfactory?—Yes, with most men.

2036. What were the diseases that you observed in these men during the winter months?—When entering into winter quarters, before the ship was quite settled down for the winter, we had a few cases of catarrh; we had 12 cases of frost-bite; two of colic; two of exhaustion from sledging in the autumn; one case of dyspepsia; two cases of dyspepsia and

debility combined, one of phlegmon, and one of sprain.

2037. Among the cases of frost-bite, had you any severe ones?—We had three wherein it was necessary to remove the great toe or part of it by amputation.

2038. Have you formed any opinion relating to the physiological action which causes frost-bite?—I am inclined to think it is owing to the circulation ceasing in the part and producing mortification.

2039. You mentioned catarrh; were these catarrhal symptoms of any importance?—They were not of much importance.

2040. Have you made any experiments on the presence or absence of ozone in the atmosphere?—Yes.

2041. Will you give the result of these experiments to the Committee?—I merely took the amount of ozone from day to day; it varied from one to nine.

2042. (*Dr. Fraser.*) What scale did you take?—I merely took Negretti and Zambra's shade scale.

2043. (*Dr. Donnet.*) Do you think that the presence of ozone in the atmosphere has a stimulating effect upon the system, and that, when absent, a degree of debility is generated?—It is generally thought so I believe, but I cannot state myself from experience that it is so.

2044. Were any experiments made to measure the electric state of the atmosphere?—I think so by Lieutenant Parr.

2045. Do you know whether a deficiency of electricity was found?—I think the amount of electricity was small.

2046. Did you witness any thunderstorm in the high parallel of latitude of your winter quarters?—None whatever.

2047. Do you think that this non-electric state of the atmosphere was in any way conducive towards producing any effect upon the men's health?—I could not say. It did not appear to do so during the winter.

2048. Having heard the evidence which has been already afforded the Committee with regard to the ventilation and warming of the "Alert," I would like to have your opinion, as the medical officer of the ship, whether these systems were pushed to their possible limits and rendered as good as they could be made under the circumstances?—They were pushed to the greatest possible limits on the plan adopted, compatible with the cold of the external air.

2049. On looking over your report of examination made of the men, I would wish to know whether in the selection made of these men you established any difference between those who were of a sanguine and those who were of a lymphatic temperament; and have you formed any opinion with regard to which of the two would offer the greater resistance to the evils which are encountered in the arctic seas?—I have made no particular observations on that point save ascertaining the number of dark and fair men who were on board.

2050. Did you observe any difference between these dark and fair men as regards strength and health?—I observed no difference.

2051. Was each sledge party provided with medicines, medical appliances, and comforts, and with medical instructions?—Yes.

2052. Were these instructions framed by yourself, or were they supplied by you for the use of sledge travellers before leaving England?—They were framed by myself. My instructions were "a small supply of such surgical appliances and medicines as might be considered by the senior medical officer of the ship suitable for meeting slight ordinary casualties and illness, with clear and well-defined instructions for use, should be placed in charge of the officer commanding the party, and the petty officers in charge of the sledge should be practically instructed in the use of such appliances before leaving the ship." It was my study for a long time as to how I could

carry out this recommendation, as I had no guide whatsoever in any book of arctic travel to direct me. I did get some hints from a manuscript kindly lent to me by Sir Leopold M'Clintock, and taking those as the basis I made out a scale of surgical appliances and medicines for sledge travelling. I wrote clear and well-defined, though minute instructions for the use of these appliances and medicines in the treatment of the slight ordinary casualties and illness that might take place. Those instructions I gave to the sledging officers to copy into their sledge journals, and I corrected their manuscripts afterwards, and I taught the petty officers of sledges the use of certain medicines and appliances. (Appendix 19).

2053. In these instructions was provision made for scurvy?—There was no mention of scurvy in them.

2054. Could you give any reason for the omission of instructions upon this point?—I followed out the instructions I had received, which were to give a small supply of such medical appliances and medicines as might be considered by the senior medical officer of the ship suitable for meeting slight ordinary casualties and illness, and to give clear and well-defined instructions for use.

2055. In reference to an answer you gave Dr. Fraser with reference to the omission of lime juice in the sledge journeys, I would wish to ask you whether Sir George Nares, when saying that he could not give the lime juice, gave any reason for not doing so?—He said to the effect that it could not be sent unless other things most essential to sledging were left out. I afterwards ascertained that its weight, and that of the fuel required to melt it, were the reasons for its not being sent.

2056. Are you acquainted with the various sledge dietaries of antecedent travelling parties, and do you know the ration of lime juice taken by each party, and whether it was omitted in any one of these parties, and with what result?—I am aware of some dietaries of sledge travelling of other expeditions, and am aware that some had lime juice in the scale.

2057. Although you have already entered into the details of the cases of scurvy, I would ask you to give a general sketch of the prominent symptoms which the men of the more extended parties presented, and those of the men only away for a short period, and to say whether the length of these journeys made any difference in the symptoms of each?—The difference was only in degree between men who were away for a long time and those who were away for a short time. The symptoms of scurvy in the men who were away least were not so fully developed as in the men who had been away a longer time.

2058. May I ask you whether the greater hard work to which the men of the extended parties were subjected had any influence upon the severity of the symptoms?—I should say certainly.

2059. In the symptoms which you observed, what expression had the countenance of these men?—The colour was generally sallow, but, as a general rule, there was not the depression of spirits that I had been led to expect would take place in scurvy.

2060. You mentioned debility as one of the symptoms: was syncope ever present?—Yes.

2061. Were breathlessness and palpitations frequent as symptoms?—Yes, with some.

2062. Had you any hæmorrhages?—With some, from the gums and the nose.

2063. Was hæmoptysis, or hæmatemesis, or hæmaturia, ever observed?—I do not think so. I do not think hæmoptysis did occur in any case.

2064. Did you remark loss of vision in any?—No.

2065. Was their intellect clear?—Very clear.

2066. Were they conscious of the disease under which they were labouring?—Yes.

2067. And if so, did they not feel depressed?—A few of them only, not depressed to the extent I had been led to expect.

2068. You mentioned rigidity as a frequent

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symptom; was this rigidity attended with much hardness?—Yes.

2069. Was any histological examination made of the blood of any of the patients who fell under your care?—We made no experiment on the blood; we did not think it judicious to abstract any from any man, even to any extent.

2070. Did you attribute the rigidity to the effusion of the fibrinous portion of the blood in the deep-seated cellular tissues?—I looked upon it as such, but I had no means of observing.

2071. You mentioned having given three ounces of lime juice to the patients that fell under your care. Were the symptoms readily dissipated under this treatment?—That was generally the greatest dose I gave. I gave from one to three ounces to sick men. The men mended under this treatment.

2072. Have you any opinion as to the especial element contained in this juice which endows it with the properties it possesses; do you believe that citric acid is the active principle of the juice, or, with others, do you attribute the virtues of lime juice to the salts of potash it is said to contain?—My own opinion is, that it is the citric acid in natural combination in the juice to which the good quality can be attributed principally, and malic and tartaric acids I think also act beneficially.

2073. Do you think that citric acid in a crystallized state would possess equal qualities with lime juice?—All experience is against it as far as I have read.

2074. In the absence of antiscorbutics have you heard of gunpowder having been used and given with good effects in cases of scurvy?—I cannot call to mind that I have heard of it.

2075. What amount of fresh meat were you able to give your men?—We were only able to give them 14 dinners in 10 months after entering into winter quarters.

2076. Was this due to the small number of live animals killed in the winter quarters of the "Alert"?—Yes. The sick men had more. To the worst of my scurvy cases I was able to give 45 days fresh meat.

2077. In your medical experience you may have observed that scrofula, rickets, and deformities, and an arrest of development are common in habitations where light has no free access; and that in bakers, printers, glass blowers, and others whose employments keep them up late at night, a sickly appearance is observed. Have you any reason to believe that the men of the "Alert" suffered in like manner from the great number of days of darkness experienced?—As they expressed themselves well at the end of the winter I cannot say that the darkness injured them, save that it predisposed them in all probability towards sickness.

2078. Had the great cold to which your men were subjected any influence as a predisposing cause to scurvy?—I think it had.

2079. Will you afford the Committee the results of your personal experience with regard to cold—how it acted upon you physically and mentally?—I myself passed the winter in a good state of health, though I did expose myself in taking exercise every day on the floe. I only got weak and ill afterwards when I was deprived of my regular exercise and rest through nursing sick men. As to my mental state, I was in good spirits all the winter.

2080. From the experience you have had of the outbreak in the "Alert" I believe you consider that the remote and essential cause of this outbreak was to be attributed to the absence and deprivation of fresh vegetables. Do you consider that prolonged abstinence from vegetable juices is the essential cause of scurvy?—I do think so.

2081. Have you always looked upon lime juice as an indispensable ration on board a ship?—Decidedly so where you have no fresh vegetables.

2082. In your nosological return for midsummer quarter, 1876, I read the following, that "though

preserved vegetables and lime juice were issued in the quantity recommended during the winter to each person under inspection, and with the greatest care, they seemed to have failed in washing off the scorbutic diathesis, if such was established before the spring." Are you then of opinion that lime juice possesses a protective power against scurvy in some way similar to that which vaccine matter possesses against small pox?—No, I am not.

2083. Have you any reason for believing that whilst men are taking lime juice, though exposed to conditions which induce scurvy, they are fortifying their blood against a future invasion of scurvy?—Not fortifying themselves against any future invasion of scurvy.

2084. I believe you say that a double allowance of lime juice was served out to the ship's company previous to their starting on their sledge parties?—Yes.

2085. Would you say that men's systems when saturated with lime juice possess any greater power or any immunity against an attack of scurvy?—It protects them at the time from scurvy; it is a preventative of scurvy breaking out in their systems while they are taking the lime juice.

2086. By the term "scorbutic diathesis" which occurs in your nosological return, am I led to believe that you consider that the disease may undergo a period of incubation in the system; and is any importance to be attached to the observation made by Alexander Gray, one of the ice-quartermasters of the "Discovery," mentioned in Lieutenant Beaumont's Report, that many of the men in whale ships have it "lying betwixt the flesh and bone all the winter"?—I do not think there is any incubation, nor do I believe in Alexander Gray's theory on the subject; when I say "incubation" in regard to scurvy, I do not mean that there is not a state in which the blood gradually gets depraved before the more prominent symptoms of scurvy appear.

2087. Much of the evidence already afforded to the Committee is in favour of a small ration of spirits forming part of the sledge dietary. Have you considered this question of alcohol, and in your experience have you found that complete abstinence is more favorable towards the endurance of severe bodily labour in climates such as the arctic regions?—I do believe that abstinence from spirituous liquors is beneficial in the arctic regions. As far as my personal experience went, I abstained from spirits all the winter as well as from beer.

2088. And from your personal experience were you benefited?—I felt no ill effects from not taking them.

2089. Can you inform me whether the exhibition of a moderate quantity of spirit will increase the bodily vigour of men subjected to hard work such as these men were obliged to undergo; or would you say, *ceteris paribus*, that total abstainers would be able to undergo as great an amount if not greater?—It will not increase the bodily vigour under very hard work; it will have but a temporary effect.

2090. Have you remarked that frost-bites will attack the spirit drinker more readily than the abstainer, especially when the stimulating action of the alcohol has passed away?—One of our total abstainers was severely frost-bitten, and so were several men who were not abstainers.

2091. Was this owing to the very great cold they had been exposed to?—The cold and the wet.

2092. If in any future arctic sledge party weights are to be considered, and essential importance attached to them, and if one article is to give way to the other, would you not say that rum should be omitted, and lime juice substituted in sledge travelling?—My own belief is that it would be better to send the lime juice than the rum.

2093. In evidence given, objection has been made to the use of bottles for carrying the lime juice. Can you suggest any other method by which it might be

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carried?—It might be carried in the very cold weather in a frozen state in canvas bags.

2094. Do you attach importance to the lime juice being freshly made?—I think our lime juice was good all through. I could not say whether it was better when we left England than when I used it with my scurvy cases; it seemed to act equally at all times when I used it.

2095. If spirit is considered a requisite in arctic travel would not the amount of ten per cent. of strong Demerara rum, which is contained in lime juice, serve as a substitute for spirit?—It certainly would in part.

2096. Do you know of any antiscorbutics used by the Esquimaux?—The Esquimaux use, at Disco, the scurvy-grass, and the skin of the narwhal is thought good, and the flesh of the walrus.

2097. With regard to the diet supplied to your ship, would you say that the quantity of fatty matter contained in the preserved and salt meats proved sufficient for maintaining the strength and endurance of the body, and for keeping up its temperature?—I do consider that there was sufficient fatty matter.

2098. Have you found amongst the officers and crew any desire for a greater quantity of fatty matter and do you think that butter would be an improvement to future arctic diet?—The men expressed no wish for more fatty matter. Butter would be useful as a change.

2099. From your experience would you say that the food which supports the body would be also that which most warms it?—Yes, most emphatically.

2100. Do you think that the difference of taking the food hot or cold has any comparative effect on the sustaining power or increasing animal warmth?—I do.

2101. Was any preference given by any of the men in this respect?—They preferred all the food hot, except preserved meat, which some of them preferred cold.

2102. Have you any suggestions to make towards the improvement of the diet of arctic ships, such as condensed milk, for instance?—Living on board ship, as we did in the "Alert," with very little fresh meat, it would be most beneficial that the men should have sauces and condiments of any kind to enable them to eat a sufficient amount of preserved meat; also milk would be most useful; wine, again, would be most beneficial.

2103. Is the immunity against scurvy which the Esquimaux are said to enjoy over Europeans due to the greater quantity of fatty matters they consume, or is it dependent upon some circumstance of which we are as yet ignorant?—The Esquimaux do constantly suffer from scurvy.

2104. (*Admiral Inglefield.*) Do you speak now of the Esquimaux in the Danish settlements, or of the savage ones?—I have no experience of the savage ones. I am speaking of the ones at the Danish settlements.

2105. (*Dr. Donnet.*) Do you consider blubber as an antiscorbutic or as a heat producer, and that only as the latter it may be considered as an antiscorbutic?—I should think only as the latter.

2106. From your experience and observation in the arctic regions I would venture upon asking you to lay before the Committee your opinion upon the question of acclimatisation, whether a white race of European or American origin can become possessed of an immunity against the dangers of these seas by a continued sojourn, or whether the remark made by Middendorf that the high north deteriorates the constitution of the blood, and that after three winters very few can stand the fourth, is not based upon sound experience?—My belief is that an extreme cold climate as well as an extreme hot one tends to deteriorate the human system. My belief is that white people will deteriorate in health in extremely high latitudes.

2107. From the evidence you have afforded to the

Committee, I gather that though you consider lime juice, or other succulent vegetable juice, essential in the naval service generally, and in the arctic seas especially, towards warding off the scourge of scurvy, yet there were in your expedition influences at work which you believe may have acted as predisposing causes towards this outbreak. Admitting these predisposing causes, may I ask you whether you consider that such influences may possess greater force at one time than at another, and may develop scurvy more readily in certain years than in others?—Yes, in so far as you may have greater cold one year than another.

2108. (*Admiral Sir R. Collinson.*) We have had it in evidence from you that altogether 36 men belonging to the "Alert" were seized with scurvy; and it has also been brought to our notice that there were only 18 men on board the "Discovery" seized with it. Can you give us your opinion as to why the disease did not attack the crew of the "Discovery" so intensely as it did the crew of the "Alert"?—They had less sledging in that ship, and the number was less.

2109. Had they a greater supply of fresh meat than the "Alert"?—Yes.

2110. Would you think that was a reason also?—I think that was a reason also.

2111. So far as the accommodation of the two vessels went, we have been given to understand that the space allotted to the crew of the "Alert," was much better in every way than the space allotted to the crew of the "Discovery." Is that your opinion?—I heard no complaint of the space in the "Discovery" ever at any time, nor on board our own ship, except for purposes of holding theatricals in the "Discovery," for which they had to build a theatre on the ice.

2112. Comparing the size of the lower decks of both ships with the number of men who wintered on board them, which had the greatest cubic space per man?—I could not say.

2113. We have heard that when Captain Aldrich arrived at the depot, he found a jar of lime juice; was that sent at your recommendation?—I did not especially mention about that.

2114. You did know that it was sent?—I had no knowledge. I knew that there was lime juice in the depot, but I did not know that this particular jar which you mention was sent.

2115. Have you ever seen lime juice frozen?—I did freeze a small bottle myself one day.

2116. What occurred; did it break the bottle?—It lifted the cork.

2117. Did you test that lime juice afterwards in order to ascertain whether it was in any way deteriorated by going through the process of freezing?—No.

2118. It appears from your evidence that the following men, Petersen, Burroughs, and Kemish, were all attacked by scorbutic symptoms; were they regularly supplied with lime juice up to the period of their being attacked?—Yes.

2119. Consequently in their case the lime juice was no preventative?—It did not prevent certain symptoms of scurvy coming on.

2120. It appears that one of the men who held out to the last upon the northern sledging trip was called Adam Ayles, and he was a total abstainer, I believe. Can you now recollect the condition in which he came on board the ship?—I have it here. He had slight rigidity of the hamstrings of the left leg.

2121. Was he in better condition than any other of the men who came back?—Yes, he was the best.

2122. Would you attribute that to his being a more powerful man altogether, or to the fact that he was a total abstainer?—I would put it down greatly to his temperate habits and also to his powerful and vigorous frame of body.

2123. With respect to the diet of the men during the winter, do you think that if the men had been

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given a larger ration of meat, they could have consumed it?—We did increase the ration of meat.

2124. But I mean to a greater extent than what you did?—I think they had quite sufficient.

2125. (*Admiral Inglefield.*) Were the symptoms of scurvy which were exhibited by the men who complained on board the ship the same as those recognised in the cases of those who sledged. For instance, you spoke of a man who had remained on board all the winter and yet was attacked; I want to know whether the symptoms under those circumstances were the same, or whether those brought on by extraordinary exertions were different?—There are several symptoms in scurvy, and the men who worked most, apparently, and were away the longest, had all the symptoms developed, or more of them than the men who remained on board, and the symptoms were more aggravated in the men who were away a long time, than in those who were attacked on board.

2126. Is it not the case that men with a slow circulation of the blood are more likely to be attacked by frost-bite than men who have a quick circulation?—I should think so.

2127. With reference to provisions; do you consider that the compressed form of tea is equally good as the ordinary form?—The sledging parties spoke so highly of the compressed tea, that I am inclined to think that it is better.

2128. Do you remember, and have you a copy of the exact instructions you gave to Commander Markham?—Yes.

2129. Were they the same as those which were issued to all sledge parties?—Yes, they were the same.

2130. These instructions are called for, but I should like to know briefly, did they contain distinct instructions as to the symptoms of scurvy when first making its appearance, and how to treat them?—No, there was no allusion to scurvy in them.

2131. No allusion to scurvy in these instructions to the sledging parties?—No.

2132. Then what were the instructions that you gave?—I gave instructions on all slight cases of diseases supposed to break out in arctic service.

2133. But surely in reading the accounts of other voyages you must have had it in your mind that it was possible that symptoms of scurvy might develop themselves even after one winter?—I acted up to my instructions in issuing my instructions to the officers of the sledging parties. I gave them in writing directions which I inferred from my instructions.

2134. These instructions were issued to you by the commander of the expedition, by Sir George Nares, were they?—No, by the Medical Director-General.

2135. Then in making use of those as your guide you considered that the supply should only be such as might be considered necessary for meeting ordinary slight casualties and illness?—Yes. I will answer your question in this way: It was my study for a long time as to how I could carry out this recommendation, as I had no guide whatsoever in my book of arctic travel to direct me. I did get some hints from a manuscript kindly lent to me by Sir Leopold M'Clintock; and taking those as the basis I made out a scale of surgical appliances and medicines for sledge travelling. I wrote clear and well defined, though minute instructions for the use of these appliances and medicines in the treatment of the slight ordinary casualties and illness that might take place. Those instructions I gave to the sledging officers to copy into their sledge journals, and I corrected their manuscript afterwards; and I taught the petty officers of sledges the use of certain medicines and appliances. (Appendix 19.)

2136. Then you received no instructions from Sir George Nares to teach the officers in charge of the sledge parties what would be the symptoms should scurvy occur, and what remedies should be applied?

—I submitted my sledging instructions to Captain Nares for any emendations or suggestions which he thought proper to give me.

2137. And were those approved of by him?—Yes; he gave them back to me without any comment.

2138. Without any corrections or additions?—Without any corrections or additions, or any criticism of any kind.

2139. Then as a matter of fact the instructions to the officers in command of the sledging parties contained no allusion to the possibility of scurvy breaking out or the remedies to be adopted in such a case?—I told Captain Markham that if scurvy did break out he had better give the men as much onion powder and potato as he could.

2140. That was contained in a verbal communication?—Verbal; and I also pointed out to him that when a man complained of internal pains and occasional spitting of blood, he would be good for nothing but to be taken great care of and given as much food as possible, and that that man had probably scurvy.

2141. Do you think that the eating of tea-leaves is useful as an antiscorbutic?—I could not say; I should think very little use.

2142. You are aware that it was practised in some of the sledge journeys?—Yes.

2143. What is your opinion of the use of tobacco either by smoking or chewing?—I should think a little of it is no harm in sledging.

2144. If the men had been subjected to all the vicissitudes of an arctic winter without the darkness, do you think that the effect would have been the same, or do you lay great stress upon the prolonged night?—It would be impossible for me to say whether it would be the same or not, unless I went through a period where you had not darkness.

2145. The reason I ask this is because especial stress has been laid by some of the evidence that has been put before the Committee upon the fact that the greater length of night had much to do with the breaking out of scurvy in the expedition. Is that your opinion?—As a predisposing cause it had.

2146. Were pickles supplied to the expedition?—Yes.

2147. Was beer taken?—Yes.

2148. And spruce beer made?—No.

2149. Are you aware that Sir Edward Parry attributed the greatest antiscorbutic effect to beer?—I am not aware particularly of Sir Edward Parry's expression, but that is the opinion of all men I have read about who spoke about beer in the arctic regions.

2150. Mustard and cress was grown, I think, under your special supervision, was it not?—Yes.

2151. What quantity was grown, and do you consider that that was as efficient, though of a pallid colour, as if it had been green?—But small quantities could be grown on board, and I do not think it has much virtue as an antiscorbutic, either green or pale.

2152. What quantity of scurvy-grass or sorrel was obtained?—No scurvy-grass.

2153. Nor sorrel?—For a short time we could get stunted sorrel on the hills.

2154. Captain Allen Young describes on the 26th, I think, of August, that there was a quantity of vegetation about Littleton Island; was not that the case at your winter quarters?—There was a good deal of vegetation around our winter quarters in the summer.

2155. And amongst that no herbs that you could eat?—Sorrel.

2156. Only?—Only.

2157. But not in large quantities?—Very stunted and not in large quantities; spread over a great surface, but the quantity was small. It grew in patches here and there.

2158. Can you give the Committee any information on the subject of the present inquiry which your experience of the recent arctic voyage has sug-

gested with regard to the outbreak of scurvy in the recent arctic expedition; any thing that suggests itself to you after your experience and all that you have heard?—I would certainly suggest that lime juice be sent on all arctic sledge travelling in the latitudes that the “Alert” and the “Discovery” were in, if it can be possibly done.

2159. Has it occurred to you that the lime juice might be safely carried in skin bags in the form of capsules, for instance. You spoke of carrying it in canvas bags; that of course would, as soon as it melted, leak, but in skin bags or capsules it would matter little whether it was frozen or melted?—Of course it would be very beneficial to send it in a smaller compass than lime juice itself in the frozen state.

2160. Captain Markham informed us that on his journey he melted a sufficient quantity for the number of sick men of his party by putting the bottle containing the lime juice into his bag—that he thus melted a sufficient quantity for four or five men, I think he said. Under these circumstances it is clear that if each man's ration could be made up in a capsule there would be no expenditure of fuel necessary to thaw the quantity for him to take as his day's ration. Do you consider that practicable?—Do you mean that he would have to take the capsule without water?

2161. He might then mix it with his tea, or in any other way that was thought fit to administer it?—If it is taken in a concentrated form water must always be made to be taken with the juice.

2162. Do you see any objection to its being mixed with the ration of tea?—I do. I do not think it would be at all appreciated.

2163. It would be unpalatable, you mean?—Yes.

2164. Was bread baked on board your ship?—Yes.

2165. How often?—We had it three days out of four after a time, and two days out of four before that.

2166. Do you consider that if lime juice had been administered during the journey to the crews who were thus employed there would have been less scurvy, or that it would have been in a less severe form?—I do believe that if lime juice had been sent it would have modified the disease.

2167. (*The Chairman.*) Are you of opinion that it would have averted the disease altogether?—I cannot state what it would have done in that way, but I believe it would have modified the disease when it did break out. I cannot say that it would have prevented the outbreak, but it would have modified it when it did break out.

2168. And that in all probability it would have delayed the outbreak?—Yes.

2169. Have you any reason to suppose that from the natural anxiety on the part of the officers and the men to get through as much travelling as possible, they made longer journeys at the commence-

ment than was desirable?—It is quite possible that they did.

2170. Are you aware that the general equipment of the expedition, including of course the dietary both on board the ship and for the sledge parties, was recommended by a committee of officers who had long arctic experience, and were termed “The Arctic Committee,” and who were assisted by medical officers who had experience of the same description? Under these circumstances I trust you did not consider yourself slighted as surgeon of the ship, in not being consulted upon these points, as you had no previous arctic experience?—No, I never thought I was slighted in anything regarding this question. When I use the word “slighted,” I mean done intentionally in any way.

2171. And during your service on board the “Alert,” you always felt yourself perfectly free, according to the custom of the service, to make any representations you thought proper in regard to your special duties?—Always.

2172. Were you entirely satisfied with the equipment of the ship for the special service in which she was engaged, speaking generally?—I beg to state that I was not entirely satisfied, 1st, with heating the ship by means of stoves placed here and there; 2nd, with the ventilation, for I preferred a system where heated pure air, instead of cold, could be admitted as much as possible.

2173. The returns which we have requested you to furnish are as follows:—First, Medical Instructions issued for the guidance of the officers in command of the sledge parties (Appendix 19); Secondly, a Chemical Analysis of the air in and outside the ship while in winter quarters (Appendix 20); and Thirdly, a Return of weights of the ship's company?—Yes.

2174. (*Dr. Fraser.*) You have answered some questions in reference to the paragraph in the memorandum of the Medical Director-General requiring you, as the Senior Medical Officer of the ship to furnish advice as to the supply of such surgical appliances and medicines as might be considered “suitable for meeting ordinary slight casualties and “illness, with clear and well defined instructions for use.” You were, of course, perfectly aware of the existence of this paragraph?—Yes.

2175. Can you offer any explanation as to why you did not, in the instructions which I understand you issued, refer at all to the question of scurvy, or to the supply of any special antiscorbutic?—I did speak to Captain Nares about sending away the special antiscorbutic on the sledges, and I followed out the instructions I received by giving to the sledging officers instructions regarding all slight ordinary casualties and illness that might occur.

2176. You, I understand you to say, did speak to Captain Nares as to the supply of lime juice?—Yes.

2177. With what result?—The result was that it was not sent.

The witness withdrew.

Adjourned to to-morrow at 11 o'clock.

THURSDAY, 18TH JANUARY, 1877.

PRESENT:

ADMIRAL SIR JAMES HOPE, G.C.B., in the Chair.

VICE-ADMIRAL E. A. INGLEFIELD, C.B., F.R.S.

JAMES J. L. DONNET, Esq., M.D., Inspector of Hospitals and Fleets, R.N.

THOMAS R. FRASER, Esq., M.D., F.R.S.E.

H. J. VANSITTART NEALE, Esq., Secretary.

THOMAS COLAN, Esq., M.D., Fleet-Surgeon, R.N., *further examined.*

2178. (*Dr. Fraser.*) In your examination of yesterday you stated that the air in the ship had been chemically examined, I think, by Dr. Moss, and you

also stated the general results of the examination, at which I expressed some surprise; have you a desire to make any further explanation on the subject?—I

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submitted the paper to Dr. Moss in which he gives me the results of his experiments with the carbonic acid, which statement is correct as far as he knows, and in which the air of the lower deck, examined at a time when all the men were in bed for two hours and all the men were in their places, gave a percentage of between $\frac{1}{4}$ and $\frac{1}{2}$ of carbonic acid by his examination.

2179. Do I understand you to say that you have a return from Dr. Moss in your hands on that subject?—Yes.

2180. Could you give in that return?—It is called for already. (Appendix 20).

2181. Does this return give any results of the examination when the lower deck was less occupied than at the time you have stated?—No.

2182. Does it give any results of the examination of the atmosphere outside the ship or in the open air?—Only a note to the following effect: "The estimation of carbon-dioxide in the external air gave results not differing widely from the average of pure air in Europe." The results cannot be fairly stated without a long description of the three various methods

The witness withdrew.

EDWARD MOSS, ESQ., M.D., Staff-Surgeon, R.N., *examined.*

E. Moss, Esq.,
M.D., Staff-
Surgeon, R.N.

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2187. (*The Chairman.*) On what day did you join the "Alert"?—On the 15th of April, 1875, the day she was commissioned.

2188. Did you belong to her till she was paid off?—Yes.

2189. Enumerate the sledge journeys in which you were personally engaged.—A short trip of three and a-half days in the autumn of 1875; a trip to Cape Joseph Henry and back between the 3rd of April and the 14th of April, 1876; a second trip to the same Cape and back between the 23rd and the 30th of April, 1876; a trip to near Cape Joseph Henry in order to meet Captain Markham's returning detachment, on the 8th of June, and the return to the ship; and a short trip I think of two or three days to Black Cape for the purpose of assisting Lieutenant Egerton in soundings and thermometric observations.

2190. (*Dr. Fraser.*) With the exception of this one trip of four days in the autumn, your other four trips were in the spring and summer of 1876, I understand you to say?—Yes.

2191. What sort of sledge had you in the autumn trip?—I accompanied a dog-sledge under the command of Lieutenant Aldrich.

2192. How many men besides yourself and Captain Aldrich were there?—Four men and three officers.

2193. What provisions did you carry?—We did not carry a sledging dietary of provisions, we used rum instead of tea for lunch, and preserved meat instead of pemmican for meals.

2194. Did you carry any vegetables?—We took preserved potatoes and biscuit.

2195. And was the ordinary sledge allowance of preserved potatoes and any other vegetable served to the crew?—I do not know what the allowance was at that time.

2196. Did you yourself eat the preserved potatoes?—Yes.

2197. So far as you know, did all the other men eat the preserved potatoes?—Yes.

2198. But you do not know what quantity?—I do not know what quantity in that trip.

2199. Had you any sickness in that trip of four days?—No.

2200. Did you carry lime juice?—No, I think not.

2201. Your next trip appears to have been when the spring sledging parties departed from the "Alert"?—Yes.

2202. Were you at all employed in examining the crews selected for the spring parties?—Yes, I was present when four of them were examined.

2203. What was your general opinion of the physical condition of the men and their state of

employed to meet the difficulty caused by the low temperature of from $-25^{\circ} 5''$ to $-63^{\circ} 5''$.

2183. (*Dr. Donnet.*) Am I right in supposing that no night-watch was kept on board the "Alert," and that, therefore, all the men went below at the same time?—Save the Quartermaster of the watch, who possibly might have been between decks at the time.

2184. I should like to ask your opinion about the effect of the fresh meat diet upon the sick of the "Alert"?—It had a most remarkably beneficial effect upon them.

2185. What quantity were you able to give to each man and for what length of time?—I only had sufficient meat to give the worst cases, and those worst cases I was able, since June 16th, to give 45 days fresh meat, the quantity ranging from half a pound up to one pound; they often got one duck between two, and so on. I gave them what I thought I could spare each day, and what I considered would do them good.

2186. Had you given to any of those sick men preserved provisions?—Yes, to most of them; in fact, I might say to all.

health, immediately prior to the 3rd of April?—With one or two exceptions I looked upon all as in good health and physical strength.

2204. Can you recollect to what exceptions you refer?—The ship's steward, George Burroughs, the ward-room steward, Kemish, and ice-quartermaster Berrie. I do not remember any other.

2205. What was the matter with Burroughs?—He had debility with swollen knees, which I have since learnt to recognize as scurvy.

2206. He was ill you mean?—He was ill.

2207. What was the origin of his illness?—It commenced with dyspepsia, attributable in my opinion to irregular habits.

2208. What irregularity?—I think that he was in the habit of taking more than his allowance of liquor, or that his allowance of liquor was too much for him.

2209. Had you any means of knowing if his appetite was fairly good?—No, his appetite was not good.

2210. In that case he probably did not consume the usual amount of food?—Probably not, but I do not know whether he did or not.

2211. Is it possible that he may, on account of his dyspepsia, and on account of his loss of appetite, have on several occasions avoided his ration of lime juice?—He was subject to the same checks as the other men, and with the exception that he himself was engaged in serving out the lime juice, I do not regard it as more likely that he did not take his lime juice than any other man.

2212. It is not within your knowledge that on any occasion he did not take his ration of lime juice?—No.

2213. Did he indulge largely in alcohol, or to what extent do you think?—I noticed its odour from his breath, and considered him somewhat dull from its effects, but my supposition that he took too much is deduced altogether from his appearance. I never saw him take any.

2214. He was under your care for dyspepsia, which you imagined might to some extent have been caused by excessive indulgence?—He was under treatment on board the ship, in Dr. Colan's care.

2215. Was he disabled for any length of time by this dyspepsia?—Yes.

2216. Have you any suspicion that at any time he may not have taken his lime juice, taking into account the circumstances which you have informed us of?—No, I have no suspicion directly applicable to his case.

2217. Do you know if, during the whole time he

was in medical care, he had his daily allowance of lime juice?—Yes.

2218. He himself was employed in serving this lime juice I understood you to say?—Yes.

2219. It was to some extent, therefore, under his control?—It was.

2220. And it is not impossible, therefore, that he may not have taken his lime juice?—The lime juice was given in the presence of an officer who was bound to see him take the lime juice as well as the other men.

2221. What officer?—Subsequently, I think, Lieutenant Egerton; at first the sergeant of Marines.

2222. What was the name of the sergeant of Marines?—Wood.

2223. What symptoms of scurvy did you first notice in this man Burroughs?—In looking back over his case with my present knowledge, I regard his dyspepsia as not unlikely to have been associated with scurvy.

2224. At that time, however, you did not suspect scurvy?—At that time I did not suspect scurvy in him.

2225. And at that time you knew the fact of his probable over indulgence in alcohol which itself might have been the cause of the dyspepsia?—Yes.

2226. Beyond this dyspepsia what other symptoms of scurvy did you discover in him?—He had swollen knees which he attributed to an injury. Subsequently he had petechiæ, and also spongy gums, and he was generally feeble.

2227. I think he recovered satisfactorily, did he not?—Yes.

2228. You mentioned also that the ward-room steward, Kemish, was not, in your opinion, in good health previously to the 3rd of April; what was the matter with him?—He was dyspeptic and irritable.

2229. When was this?—At intervals during the winter.

2230. Had he scurvy in the winter?—No, I did not consider him to have had scurvy.

2231. The third man you have mentioned as not being in good health previously to the 3rd of April, was, I think, ice-quartermaster Berrie?—Yes.

2232. When did you observe that he was not in good health?—During the winter immediately previous to his being on the sick list, about, I think, a month before the sledging. I cannot state the exact date of his being on the sick list, without reference.

2233. How had he been employed in the winter before his illness?—I am not aware that he had any special employment differing from that of the other men in his position.

2234. Had he been on any excursions from the ship?—No.

2235. Was he a steady man?—Yes.

2236. And previously to the time that you have generally referred to, was his health satisfactory and good?—Yes.

2237. The indefinite symptoms referred to Kemish and not to Berrie. What symptoms did you notice in the case of Berrie when he first became ill?—Cough, debility, and depression.

2238. Was he employed in the sledging parties of the spring?—Yes.

2239. Then he had recovered previously to the 3rd of April?—To a great extent.

2240. Do you mean that he had not recovered satisfactorily?—I did not consider him quite strong.

2241. What sledging party did he join?—He was captain of the sledge "Challenger," under Lieutenant Aldrich. He left the ship as captain of that party.

2242. Who examined him previously to the final selection of the sledge parties?—He was examined in my presence by Dr. Colan.

2243. Can you recollect what report of his state was made then?—I do not know.

2244. Is it not probable that the report must have been a favourable one, or else he would not have been selected?—Yes, I think so.

2245. This man was sent back, was he not, to the "Alert"?—Yes, I sent him back.

2246. Then you accompanied this sledging party?—Yes.

2247. And was he the first man attacked?—Yes, he must be considered as having been attacked in this sledging party, if you take the time of his attack as the time when he was first incapable of doing his duty.

2248. I think that you had greatly interested yourself in the general condition of the "Alert," had you not, so far as the sanitary state was concerned, during the winter?—The examinations which I made were only in accordance with order. I did not consider the inquiries assigned to me as directly bearing upon the sanitary state of the ship.

2249. What examinations did you make?—The estimations of the carbonic acid.

2250. Did you examine the drinking water?—Yes.

2251. Of course these are sanitary matters?—Yes, undoubtedly.

2252. What particular branches of inquiry were assigned to you?—Estimations of the specific gravity of surface and deep sea water, and of ice, and estimations of the amount of chlorine contained in surface and deep sea water, and in different parts of the ice. The air and the drinking water on board ship were only examined by me, when I received special directions to do so, unless when they came under my observation under one of the previous heads.

2253. Were you on the whole satisfied with the purity of the atmosphere on board ship?—My personal opinion was that the air could not be considered pure, but I was obliged to modify that opinion greatly by the exigencies of arctic service.

2254. You do not mean to say in that answer that the exigencies of arctic service modified your opinion of what constituted a pure atmosphere?—Yes, in this way, that I regard the atmosphere on board our ship as a necessary compromise between impurity and cold, although impure it may be considered fairly pure under the circumstances.

2255. Although it might have been necessary to submit to a compromise, still the fact of an atmosphere being pure or impure is a question totally apart from what you are obliged to submit to, is it not?—Yes, I have stated that my opinion was that the atmosphere was not pure, of that there can be no question.

2256. I do not know whether you can now give us any notion of the cubic space allowed to each person on board ship, in the first place under ordinary circumstances in the navy?—I have never heard any definite space assigned on board any ship that I served in.

2257. Can you give, from any information which you may possess, the general space, which as a matter of fact is assigned?—No, unless by the roughest comparisons.

2258. Will you kindly give us these rough comparisons?—I know the space occupied by the men in the "Alert." After the enlargement had been made in October, 1875, the cubic space of the men's deck was, deducting beams, lockers, and other fittings of the deck, and deducting the estimated bulk of the men themselves, and their hammocks and clothes, a little over 6000 cubic feet.

2259. This men's deck was used as a day living room, as well as a sleeping room, was it not?—Yes, the men had their meals there.

2260. Your main deck being subdivided, to what portion of this main deck do you refer when you estimate the cubic capacity to be 6000 cubic feet?—The forward compartment of the men's deck between the drying room and the main deck.

2261. How many men slept in this men's deck?—A variable number, up to 40; between 35 and 40.

2262. Thirty-five being the minimum, and 40 the maximum?—There or thereabouts; it was necessarily varied by the men on watch, and the number of men on board at the time.

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2263. 'This would allow, I think, about 170 cubic feet per head would it not, as a maximum?—About that amount.

2264. How was this men's deck ventilated?—The doors opening on to the main deck were frequently kept open. There was a 6-inch ventilating hole or shaft abreast of the galley on the starboard side; half of the galley hatch was kept open. There was a ventilating shaft between the foremast and the fore hatch, and the passage through the men's hatch admitted cold air, whenever it was opened as it constantly was, of course, through the night from the men passing up and down.

2265. Did all these openings communicate directly with the outside air?—The first communicated with the main deck.

2266. Which was occupied, I think, by the men?—Partly occupied by the men; it was very fully occupied by other things, by the stores, and by the whole of the engine-room funnelling. The two ventilating shafts went directly into the outer air, as did also the men's passage up and down; both the men's passage up and down and the opening into the galley opened into the snow houses built over them for the purpose of retaining heat. The door of the snow house over the galley was ordered to be kept open constantly during the night.

2267. How many of those openings were constantly available for the ingress or egress of air?—I think all of them.

2268. Did you at any time measure the area of these openings, or can you supply information upon that point?—The ventilating shafts were circular, about six inches in diameter; the half hatch over the galley was, I should say, about three feet by two feet, and there were the doors on to the main deck, which were generally open, or were supposed to be kept open. The men often complained of draught. It was extremely difficult to arrange any ventilation without one or other of the men complaining of draught.

2269. If we assume that to maintain purity of atmosphere it is necessary to supply 3000 cubic feet per head per hour, and if the cubic space occupied by each man was 170 cubic feet at the utmost, would it not be the case that to maintain the purity of the atmosphere, the whole of the air in the deck we are now speaking of, would require to be changed 18 times per hour?—That involves a calculation, but I consider that it must be approximately correct.

2270. I think also that it is generally considered that even in this climate it is difficult to effect the complete removal of the air so frequently as six times per hour, without causing a draught of a disagreeable and perhaps injurious description; and it must therefore in the climate in which this ship wintered have been absolutely impossible to maintain a pure atmosphere with the means at your disposal?—Undoubtedly.

2271. We have heard from a previous witness that you made some observations with reference to the purity of the atmosphere. Can you give us, generally, a description of your observations with the results?—My observations were made, not with reference to purity, but with reference to the percentage of carbonic acid contained in the atmosphere. (Appendix 20).

2272. I think it is the fact that that is the most usual method of estimating the impurity of the atmosphere, the percentage of carbonic acid always indicating the quantity of organic impurity; is not that so?—In my opinion the percentage of carbonic acid alone cannot be taken as an infallible guide to the purity of an atmosphere.

2273. Still the amount of carbonic acid in those cases where the impurity largely, if not entirely, is the result of respiration, is an indication of this impurity?—Yes, I have admitted that in the first part of my answer to all practical purposes.

2274. In your examination of the air in so far as this carbonic acid is concerned, can you mention to the Committee the general results which you obtained?

—The general results obtained indicated the presence on an average of between .2 and .4 per cent. of carbonic acid.

2275. That, in your opinion, was a very impure atmosphere; was it not?—I should certainly call it an impure atmosphere here.

2276. But can it be an impure atmosphere here, without being an impure atmosphere elsewhere?—Compared with interior atmospheres here and in arctic regions, it may be relatively impure, or pure. It may be the minimum impurity attainable under our circumstances.

2277. In fact, it may be regarded, I think, as an atmosphere so very impure, as, judging by the standard of the carbonic acid present, to be between four or eight times more impure than it is generally maintained an atmosphere should be in order to support healthy existence?—I do not think so. I consider that .02 per cent. would be an abnormally pure air even for the outer atmosphere. (Appendix 20).

2278. Can you tell us, if the carbonic acid be a guide to the amount of impurity, what is the maximum quantity which you consider allowable in a pure atmosphere?—I do not know that there are any published data at present, which would enable me to state at what point the deleterious effects of carbonic acid set in.

2279. Did you make any observations respecting the amount of carbonic acid in the air outside of the ship?—Yes.

2280. With what result?—The results are only of value in connection with the whole details of the method used. I refer especially to the various arrangements made for allowing air at such a low temperature to have the carbonic acid removed by baryta, and the method of titrating in the presence of the precipitate. Both these circumstances should be taken into consideration in giving any statement of the results obtained.

2281. I quite understand that the difficulties which you must have had to encounter are almost indescribable when we consider the nicety of such chemical research, still you have said, I think, that in your opinion, the atmosphere on board the ship was impure?—Yes.

2282. Can you suggest any method whereby it would have been possible to have effected a more frequent removal of the air in this deck, that is to say, to have improved the method of ventilation. Perhaps you would in the first place give the Committee some idea of the chief difficulties met with in the conditions in which the "Alert" was placed in effecting such satisfactory ventilation?—The leading difficulty was the necessity of maintaining a temperature greatly differing from that of the outside air; secondly, the limited stock of fuel; and lastly, the want of means of specially constructing many arrangements which might be useful.

2283. The great difficulty, in short, was the coldness of the outer air?—Yes.

2284. Did you ever consider the question of using the appliances already existing for heating the ship to elevate the temperature of the air admitted from outside previously to its distribution in the deck; or what is your opinion as to the application of such means?—I do not think that such arrangements as we could construct could be satisfactory, and I did not think so at the time.

2285. That is to say after you had joined the ship? I speak of winter quarters. I had no idea what the arrangements were to be until we were actually in them, and actually using them.

2286. Do you think it would have been an advantage if, in the arrangements made in this country for ventilation, means had been taken to effect the heating of the air admitted into the ship? Yes, undoubtedly.

2287. I think you at various times examined the water used for drinking?—Yes.

2288. Where was the water generally obtained?—

During the time that we were in winter quarters the water was obtained from the surface ice of a floeberg in the vicinity of the ship.

2289. Was the result of your examination such as to satisfy you that it was good drinking water?—It was very pure water.

2290. Pure in so far as the organic impurity and the chlorine are concerned, I presume?—Yes.

2291. Was this the only water that was used by the crews during their winter quarters?—Water from pools on shore was used late in the summer.

2292. What was the quality of this water, do you know?—Yes; the first brought on board was salty. This supply was stopped, and that from the second pool used was good pure water.

2293. What water was obtained by the sledging parties generally?—Water from the snow from the surface of the ice.

2294. Can you tell us anything about the quality of that water?—When taken from over old ice, and not to the leeward of masses of new ice, it was pure.

2295. I suppose it was generally understood by the commanders of the sledges that water from the undesirable positions should not be taken?—Yes; I think so.

2296. Do you know as a fact that the water used by the sledging parties was good?—Yes; the water used by the parties with whom I travelled was good, and I had an opportunity of tasting the luncheon tea in other sledges than my own. I would observe, the amount of salt in even the saltiest water that we could use for tea in sledging is less than the amount that could readily be taken with meat at a meal.

2297. Were you generally satisfied with the quality of the articles of food supplied on board ship?—Yes.

2298. We have heard something about the salt beef; have you any remark to make respecting it?—The salt beef was, I think, more salt than usual, although the quality of the meat appeared to me better than usual.

2299. Can you describe to us the form in which the vegetables were preserved?—Some were dried and compressed, others preserved moist; the potatoes, cabbage, compressed vegetables for soup, peas and pippins were dried; carrots, gooseberries and rhubarb and pickles were moist.

2300. Carrots and some fruits and the pickles were the only vegetables which were preserved in a moist state?—Yes, but there were also vegetables in hotch potch, ox cheek, and vegetables and minced collops which were moist.

2301. Generally speaking, was the vegetable food served in larger quantity from among the vegetables preserved in a dried state, or from among the vegetables preserved in a moist state? It is difficult to compare the quantity stated by weights of dry and moist vegetables.

2302. Were the potatoes served every day?—I should refer to the various dieting scales to enable me to answer that question.

2303. I hand you the scale of victualling on board ship with which we have been furnished (*handing the same to the witness*), is that the scale for victualling which was adhered to throughout the expedition on board ship, or was there any important modification at any time made in this scale?—It will take some time to compare these two scales.

2304. Can you furnish the Committee with a report stating what was the scale of victualling at different times on board ship?—Yes. I could not furnish the original one, but such as I have was hurriedly copied from the account of the officer in whose charge the victualling accounts were.

2305. What officer is that?—Lieutenant Egerton.

2306. Did you examine any of the food chemically or in any other way, at any time?—The only examination to which your question would apply, I think, was an estimation of the acidity of the lime juice.

2307. In what liquor were the moist vegetables preserved?—In water.

2308. There was no pickle or other preservative added to the water was there?—I do not know. I think, in the process of the preservation of rhubarb and gooseberries sulphurous acid is occasionally used, but I am not certain.

2309. There was no vinegar?—No.

2310. None of the dried vegetables were at any time found to be musty were they?—I recollect to have noticed mustiness on the potato when served at table, perhaps upon one or two occasions.

2311. That, however, was rarely observed?—Very rarely.

2312. And the quality of the compressed and dry vegetables was always good with very few exceptions?—Yes, very good indeed.

2313. You are aware, are you not, what the dietary of the sledge parties was?—Yes.

2314. Am I right in saying that only potato and onion were present in that dietary to represent vegetable food?—Biscuit, potato, onion, tea, sugar, chocolate, and curry paste.

2315. The last, I suppose, was served in a very minute quantity?—Yes.

2316. And could hardly be regarded as a food, but more as a condiment?—Yes, certainly, only as a condiment.

2317. Have you any opinion as to the relative antiscorbutic power of moist and dry vegetable foods?—Personally, I would prefer the moist.

2318. That is in fact, I think, the general opinion of authorities on the subject?—Yes.

2319. And in the sledge dietary there was no moist succulent vegetable?—No, it could not be carried.

2320. What is usually employed as a substitute for moist vegetables in restricted dietaries, such as we are now considering?—Lime juice.

2321. That we already know was not represented in the dietary of the sledge parties?—No. It was carried, when it could be conveyed, in a fluid state.

2322. Why was it carried at any time?—In order to supply the want of a vegetable diet.

2323. I understood you to say that you examined the lime juice?—Yes.

2324. With what result?—The examination which I made was suggested by the idea that it might be interesting to compare the present state of our lime juice with any future examination made after we reached England. It had regard only to its acidity. One cubic centimetre of the lime juice equalled 8.56 of decinormal acid.

2325. What quantity of acid do you estimate that this represents?—I do not know any more definite way of stating the total acidity of lime juice. I have made no comparison since I came home.

2326. Your fact is of course a perfectly definite one, but the object of ascertaining the acidity of lime juice is to arrive at the conclusion of how much of the normal acid constituents of the lime juice are present?—Yes.

2327. You have not yet gone into that?—No, I have not gone into that.

2328. Perhaps you can favour us with your exact analysis?—Yes, I mixed some of our lime juice with its own bulk of distilled water, and found that 25 cubic centimetres of a baryta solution, equal to 52.6 of decinormal acid, required 12.3 of the diluted lime juice for its neutralization.

2329. I presume the titration of your standard solutions was made in this country before leaving?—The titration of the baryta solution was made immediately before the experiment. The acid was of the strength which I received from England.

2330. Did you find any alcohol in this lime juice?—I did not examine it for anything but acidity.

2331. Do you know how it was preserved or prepared?—I heard incidentally that it contained alcohol.

2332. It was obtained I presume from the stores at

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Deptford?—I do not know where our lime juice came from. I am under the impression that it was special lime juice.

2333. What was the general appearance of the lime juice?—Clear and good.

2334. And how was it carried?—In large jars covered with wicker work, corked and sealed.

2335. Can you tell me if it is not the case that lime juice contains between 80 and 90 per cent. of water?—I could not give the percentage of water.

2336. Water is not an important ingredient so far as the purpose for which lime juice is usually given is concerned, is it?—Certainly not.

2337. It might be an advantage by reducing the weight and bulk, if in any circumstances it was very important to do so, to remove the water?—It might.

2338. Do you anticipate that this would, to any important extent, modify the valuable properties of the lime juice?—I think that experiment only could decide that.

2339. You think, however, that it might be a convenient form, in some cases, in which to carry lime juice?—Yes, but that answer of course must be taken in connection with my former one; it may be a convenient form, if it is proved to be a useful one.

2340. You mean to say if it is proved that the abstraction of the water does not cause any deterioration in the lime juice?—Yes, any deterioration in its therapeutical effects.

2341. If the water were abstracted by evaporation at a very low temperature in reduced pressure, do you not think that the probabilities are that the important constituents of the lime juice would not in any way be decomposed?—If the abstraction of the water was not carried to an extreme, I consider that little change could be expected under such circumstances.

2342. Is it not a fact that milk is a fluid which is extremely liable to decomposition?—Yes.

2343. It is of course a fact also that the greater bulk of the water may be abstracted from milk in order to prepare so-called condensed milk?—Yes.

2344. The probability therefore is that the same change could be effected in lime juice, which possibly is not so readily decomposable a liquid as milk?—Yes.

2345. Do you know whether the addition of sugar to milk, which has been so treated, exerts any preservative influence over condensed milk?—I understand that the addition of one form of sugar is an element in the preparation of condensed milk, but I am by no means well informed on such subjects.

2346. Sugar, however, is a necessary addition to a ration of lime juice; is it not?—I do not consider it a necessary addition to the ration.

2347. Is it a customary addition?—Yes.

2348. And sugar is usually carried, in order to add to the lime juice?—Yes.

2349. It might, therefore, be convenient, after the abstraction of the bulk of the water from the lime juice, to add the quantity of sugar which would at any rate be required to be carried, were that lime juice used as a ration?—Yes; I think so.

2350. Can you suggest any means by which a condensed lime juice, such as we have now been talking of, could, with facility, be carried during sledging operations?—If the lime juice were actually dried or reduced to anything approaching a solid state, there would be little difficulty in carrying it. It would require water to dilute it for use, and therefore fuel.

2351. It might be carried in jars, I presume, or else in skins, or in any other easily carried vessel, might it not?—I think such lime juice might be carried.

2352. Would there be any advantage in carrying it in this condensed form?—An undoubted advantage.

2353. In the four sledge parties in which you took part, subsequently to the 3rd of April, you were absent for very different periods, I understand?—Yes; each excursion was of different length.

2354. On which of the excursions were you absent for the longest period?—I think on the first excursion.

2355. With the exception of the expedition to Black Cape, you were generally absent, I think, for periods varying between a week and 10 or 11 days?—Yes.

2356. You had no very long excursion?—No, I had no long excursion.

2357. Had you cases of scurvy on all of these four excursions?—On the first and last only.

2358. How many cases had you on the first?—One.

2359. What was the name of that man?—Ice-quartermaster Berrie.

2360. On the other occasion how many cases had you?—I think the whole of Captain Markham's party, with the exception of Captain Markham himself, afterwards came under treatment for scurvy.

2361. Berrie became ill during the expedition, did he not?—He was relieved from work during the expedition on account of illness.

2362. What were the symptoms which he manifested at the very first?—On the morning of the day after leaving the ship (that is within 24 hours of leaving the ship) he complained of feebleness, slight cough, and exhaustion after effort, and he showed much depression, and much fetor of breath existed.

2363. How long did he continue with the expedition?—I sent him back on the fourth day, at the earliest opportunity.

2364. When would he reach the ship?—I do not know the date of his reaching the ship; it cannot have been more than two days, I think.

2365. The probabilities are that he reached the ship in six or seven days after the commencement of his illness I think?—Yes.

2366. During those six or seven days had he any special treatment, and what?—None, with the exception of being relieved from work; no treatment was available; I had no means of treating the case.

2367. And you do not know how he was treated on his arrival on board ship?—No.

2368. The next occasion on which you met with scurvy was when you went to the assistance of Captain Markham's party, I think?—Yes.

2369. And on that occasion you found the whole party suffering from scurvy, with the doubtful exception of one officer I think?—Yes.

2370. Did you form one of a relieving party?—Yes.

2371. How did you travel to their relief?—With a dog-sledge party which I preceded on snow shoes.

2372. Did you carry medical comforts?—Yes.

2373. What were they?—Lime juice, and a very small portion of fresh mutton, oysters, a little preserved meat, black currant jam, apple jelly, condensed milk, egg powder, port wine, champagne, and brandy.

2374. Did you yourself suffer from scurvy at any time during this expedition?—I do not think so.

2375. Had you any symptoms at all suggestive of those of scurvy?—Looking upon scurvy as a variety of starvation, it appears to me that its first symptoms are necessarily hardly to be detected.

2376. Then did you suffer from symptoms of starvation?—No.

2377. By expressing your opinion that scurvy is a variety of starvation, you mean a starvation in which certain necessary food constituents are absent, and not in which the general bulk of the food is deficient?—Yes.

2378. What is the necessary food constituent absent in scurvy do you consider?—I do not know.

2379. Have you any opinion to offer as to whether or not it be a constituent supplied usually by fresh vegetables?—In my opinion the constituent is supplied both by fresh vegetables and fresh meat.

2380. Have you had any experience of scurvy beyond this expedition?—I had seen one slight case.

2381. Then you think that scurvy may also depend on the absence of constituents supplied by fresh meat?—Yes.

2382.—You mean that some of the elements of fresh meat must necessarily occupy a place in a dietary which does not produce scurvy?—Fresh meat

or vegetables—I think one or other would, under certain circumstances at any rate, be sufficient to keep off scurvy.

2383. Do you mean that if an abundance of good fresh meat be supplied without vegetables you would not anticipate an attack of scurvy?—I would not.

2384. Do you know that attacks of scurvy have occurred under the circumstances to which I have referred?—I do not remember.

2385. Are you aware that scurvy has broken out among healthy railway labourers receiving good wages and being abundantly supplied with the best of fresh meat, but who from choice had altogether refrained from fresh vegetable food?—I am not aware of that. My reason for including fresh meat is in part derived from the sledging reports of the Search Expeditions, and (though I cannot quote directly), I think Lieutenant Mechem's journey affords an example of scurvy-stricken men so far recovering after fresh game that they reached the furthest recorded direct distance from their ship. Esquimaux have been reported living altogether on fresh meat, and not subject to scurvy so long as the supply continued plentiful, and recovering from scurvy when the season again permitted a plentiful supply.

2386. But do you know that these Esquimaux had no vegetables?—No, I did not know that.

2387. Then that case does not indicate that fresh meat without vegetables is a dietary in which scurvy is impossible?—I cannot tell, I have no proof that these Esquimaux had vegetables.

2388. Are you aware that at the close of the Punjaub War in 1848-9 our troops had an abundant supply of fresh meat and bread but no fresh vegetables, and were afflicted with scurvy?—That fact never came to my knowledge.

2389. Are you aware that during the Burmese War a detachment of our troops were victualled on fresh meat in ample quantity along with biscuit, rum, and rice, but altogether unsupplied with fresh vegetables or any substitute for them, and that scurvy broke out among those troops?—No, I have never seen those records.

2390. And further that when, with the same diet, lime juice was added, the cases of scurvy ceased?—I have never seen the records. [The date of the edition of the book which gives these instances accounts for my not being familiar with them.]

2391. Taking it as granted that these records do exist, and are authentic, do you adhere to the opinion that you have already expressed as to fresh meat being a preventative of scurvy?—I might modify my opinion if such cases had come under my observation.

2392. (Dr. Donnet.) In your first spring journeys were the circumstances under which you travelled with regard to cold, nature of the snow, and fatigue, greater than in your subsequent sledge expeditions?—Yes, I think in the main they were.

2393. Will you describe the nature of those circumstances, and the effects upon your men?—The temperature varied from -40 degrees to about -5 degrees or -6 degrees in my first trip. The snow was soft, sometimes crusted, the fatigue I think was about equal in all.

2394. You mentioned having had some part in the examination of the men; from your experience do you believe that the blue jackets are better fitted than marines for arctic sledge work?—Such has been my impression from our experience. I should choose the blue jackets myself in preference to the marines.

2395. Have you any special reasons for stating this preference?—That the blue jacket's work is somewhat less routine work; a blue jacket's work tends to make him more self-reliant.

2396. Was Berrie the only man that fell ill, or had you other men fell ill?—We had only two on the same trip that fell ill, but not of scurvy.

2397. On the various sledge journeys which you commanded how many of your men fell ill of scurvy?—None; during the time we were actually working

I never had occasion to relieve any man from duty on account of scurvy in any sledge commanded by me.

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2398. Among the men under treatment on board the "Alert," I observe that Thomas Simpson, William Ferbrache, and John Hawkins and others, suffered from hydrothorax; was this symptom dependent upon scurvy, or were there other causes at work which produced it?—I think that taking into consideration the frequency of effusions in scurvy, the hydrothorax and similar effusions in our expedition may be attributed to scurvy.

2399. I observe in Lieutenant Aldrich's report, mention made of Stubbs having suffered from hydrocele, and likewise Mann; do you believe these symptoms dependent upon scurvy?—From having seen a case of similar hydrocele myself, I consider that they probably did arise from scurvy.

2400. Did other cases with similar effusions fall under your notice?—Yes, I have mentioned one, Pearson, with hydrocele. Swollen knees were not unfrequently accompanied with intercapsular effusion.

2401. In the cases which occurred in the various expeditions where difficulty of walking was a marked symptom, do you consider that it arose from the effusion you have mentioned?—No, not from intracapsular effusion. I think it arose principally from the stiffened state of the muscles of the calf and ham.

2402. To what was this stiffness due?—I suspect to interstitial effusion. I cannot say positively.

2403. Did this symptom fall frequently under your observation?—Frequently.

2404. Did you consider it a symptom of scurvy?—Yes.

2405. Had you any case of snow-blindness?—Yes.

2406. Can you describe the symptoms which were presented in your cases?—I recollect no case in which paralysis alone constituted the disease. As a rule there were many symptoms, the contracted pupil and congested retina and the customary congestions of the eyes and cheek and eyelids.

2407. Were these symptoms sufficiently severe to oblige you to encamp for any time?—No.

2408. What treatment did you pursue in those cases?—Rest, compression, the use of lead lotions, wine of opium and Calabar bean.

2409. In your answers relating to ventilation, and especially to the frequent renewal of the air, was this renewal practicable, or were there reasons which prevented this renewal being put into practice?—I think such renewal was altogether impracticable with us.

2410. For what reason?—I think the amount of the renewal spoken of would require a supply of air by machinery.

2411. Were there any objections to a greater admission of cold air from the openings which you had in your deck?—Yes; it was extremely difficult to equalize the supply of cold air, and those men who hung their hammocks in the vicinity of the openings, not unfrequently complained of the cold and draught.

2412. What temperature did you keep the living deck at during the winter months?—The average of the places where the thermometers were hung was not far below +50 degrees I think. I cannot be more accurate without reference.

2413. Your system of ventilation and warmth I believe was effected by a distribution of stoves over various parts of the ship?—Yes.

2414. Did you think that to be as perfect a system as could be adopted?—No.

2415. What suggestions would you have made towards its improvement?—I think that all those openings meant for the down shafts should open near the lower deck and that moisture should be removed by extra means.

2416. What extra means would you suggest?—A condenser.

2417. In what way?—By means of a thin metal stopper for some of the hatchways on which the condensation might be concentrated and removed.

2418. Do you know the system which was

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adopted by the previous expedition for the purpose of warming and ventilating, which is termed the Sylvester stove system?—I am not conversant with it.

2419. From the amount of provisions and coal and stores generally, which must be taken in ships destined for arctic service, and from the nature of arctic service, would you say that a greater space for the purpose of ventilation could be afforded to the men?—No.

2420. Would it be necessary for this purpose to have had ships of a larger tonnage, and consequently of a larger size, and would you give your opinion upon this question?—I think that in order to have given greater space for ventilation it would have been necessary to have had larger ships than are known to be suitable for ice work.

2421. You state in your evidence that rum was used instead of tea at luncheon; do you believe that your party was benefited by the use of this ration?—Certainly not; many of them could not take it.

2422. Do you think rum is necessary as an article of diet in sledge travelling, it having been stated in evidence that it is considered very comforting to the men when taken at night?—I do not think it was necessary, but under the circumstances when it was taken, I do not consider that a small quantity produced as much injury as benefit.

2423. I would like to have your opinion upon the value of lime juice as an antiscorbutic?—My opinion is that lime juice is by far the most powerful known in the absence of fresh vegetables.

2424. You say that lime juice, as a rule, was not represented as a part of the sledge diet; was it carried on any special occasion?—It was carried on the occasion of my last journey to Cape Joseph Henry.

2425. Did you find any difficulty in carrying it?—Not at that time, but its bulk and weight were very great, and we had a great deal of trouble in serving it out, on account of the inconvenient vessels which it was contained in. We had a jar, and it was very hard indeed to pour the allowance out of a jar; and the jar is liable to fracture at any moment.

2426. Have you any suggestion to make towards the better carrying of this article?—I think the method before referred to of condensation is not unlikely to be a valuable one.

2427. Would you not suppose that by condensing it, it would lose some of its antiscorbutic properties?—That could only be told by experiment.

2428. Have you anything to go upon to say that it could be condensed in a space that would preserve its qualities as an antiscorbutic?—Yes, I think there is much. Throughout the whole of pharmacy, there are many condensations used which preserve the qualities of the bulkier substances.

2429. Do you think that citric acid alone would be a substitute for lime juice?—No.

2430. For what reason?—If I recollect rightly there is the experience of those who have tried citric acid. I myself have no personal experience of the use of citric acid.

2431. Have you formed any opinion upon the elements contained in lime juice which possess those antiscorbutic properties?—No, I have not.

2432. Have you any suggestions to make towards any addition to the arctic diet which was supplied to you in your ships, in the way, for example, of vegetables, fatty matter, butter, or other articles?—I would suggest much larger quantities of such palatable vegetables as fruits, preserved moist. I consider that a large supply of oatmeal would be also desirable; and condensed milk and butter would doubtless be useful.

2433. Did you take Edwards's preserved potatoes with you?—Yes.

2434. Did you find them very serviceable?—They were excellent.

2435. Do you think there would be any objection to taking potatoes and stowing them away; would

they be preserved from the influence of frost?—I think not.

2436. Did you hear of the existence of scurvy at any of the ports that you touched at in Greenland?—Yes.

2437. Did you likewise hear of any precautions taken by the Esquimaux against scurvy?—No; the scurvy with them appeared to be coincident with scarcity of food.

2438. Did you meet in any of your journeys with scurvy-grass, sorrel, cranberries, or other plants which are considered antiscorbutics?—None of the plants mentioned were encountered in any of my journeys.

2439. Are those antiscorbutics found in the high latitudes which you visited?—With the exception of sorrel, none beyond mere rare botanical specimens, and many of them not at all.

2440. Did you take glycerine as a protection against frost bite?—Not as a protection against frost bite; I occasionally used benzoated lard as a protection against the joint effects of cold and sun on my face, and it was used by my sledge crew also.

2441. Do you know whether the Esquimaux smear their bodies over with whale or seal oil, and if so with what effect?—I do not know.

2442. In the cases of scurvy which you had on board the "Alert," were you able to make any observations upon the urine, upon its specific gravity and the presence of albumen or salts?—At Dr. Colan's request I not unfrequently examined the urine of various cases but never met with any condition which appeared in the slightest degree remarkable or connected with scurvy.

2443. Was the urine of a high colour or of a natural?—It varied so much that I could draw no deduction. The examinations of urine were all greatly modified by the diet on which the men were.

2444. I believe you served at Esquimaux?—Yes.

2445. Did you observe any scorbutic symptoms amongst the Chenook Indians?—I recollect swollen and scaly limbs which may have been associated with scurvy.

2446. I would like to have your opinion upon the value of tea in the arctic regions?—I think that the compressed tea was most invaluable. Our work, after the tea for lunch, was always better and more spiritedly done, than that before lunch.

2447. You gave the preference to the tea over the spirits?—Undoubtedly.

2448. What is your opinion upon the cause of the outbreak of scurvy in the expedition?—My opinion has been that we were exposed to an increase of all arctic conditions, conditions which are already known to favour scurvy, without a corresponding increase of prophylactics.

2449. May I ask what you mean by prophylactics?—Fresh meat, fresh vegetables and lime juice.

2450. Did you allude particularly to the northern sledge party?—To all the parties; ships' and parties as well.

2451. To what especial prophylactic do you allude in the case of the sledge parties, as there would have been a difficulty for them to carry the articles which you mention as prophylactics?—Fresh meat and lime juice. I do not mean to say that we with our means could have altered the circumstances, but merely that the circumstances existed.

2452. (*Admiral Inglefield.*) Can you inform the Committee as to the effect of beer in cases of scurvy, and whether it was generally supplied to the expedition?—We had beer. I have no opinion to offer as to its effects on scurvy.

2453. Was spruce beer supplied on any occasion?—No.

2454. Are you of opinion that all the ration of lime juice was taken during the winter by the men?—I think so.

2455. If lime juice could have been carried in small quantities, such as has been suggested, and thawed by melting as has been suggested by one of the witnesses, might it not have been mixed with the

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tea?—I think so, but one of the leading difficulties encountered in carrying it was the difficulty of carrying the frozen lime juice in a vessel which would keep it safely when it thawed, and at the same time possess a sufficiently large opening to enable us to scoop out the lime juice when frozen.

2456. I am suggesting that it could have been carried in capsules or bladders?—I think, if carried under such circumstances, it might be thawed in the tea.

2457. Would it have been very unpalatable?—I think so.

2458. You have mentioned that small quantities of sorrel were collected but not scurvy-grass, and I think that mustard and cress was grown?—Yes, a small quantity.

2459. Why should not it have been grown in a large quantity?—From the extreme difficulty that we found in sowing even the smallest quantity.

2460. How was it reared?—It was reared on pieces of moist flannel in the upper part of our cabin, and it was also reared in large shallow trays of earth, but the greater part of the attempts were altogether unsuccessful.

2461. Did you find it as good as regards its antiscorbutic qualities?—Doubtless the qualities were good.

2462. Was jerked or smoked beef carried on the expedition?—No.

2463. Have you any notion that the men, if they had been acclimatized by previous arctic service, would have been less susceptible to an attack of scurvy?—I think that the men disposed to scurvy might have been weeded from the expedition by such means, but I do not consider that acclimatization would have tended to have made them more healthy.

2464. Did you make any special observations on the different effects of cold on the Esquimaux and on Europeans?—We had no opportunities.

2465. But you had those Esquimaux drivers or interpreters on board?—Yes, one.

2466. Were they more susceptible to cold than the Europeans?—We had only one Esquimaux, and he complained more of cold and fatigue than the Europeans did under the same circumstances.

2467. In your evidence just now, you said that you considered that compressed tea was a very valuable provision; do you consider it as good as the tea carried in the ordinary way?—Much better.

2468. Is that on account of its retaining its quality?—Yes, on account of its retaining its flavour and the more quickly parting with its virtues.

2469. It is stated that the men sometimes used to eat the tea leaves; do you consider that there were any antiscorbutic effects derived from eating them?—I think that they may possibly have assisted as an antiscorbutic.

2470. During the winter months was it not customary to talk amongst yourselves about scurvy and its symptoms and effects and remedies?—Any thing tending to the suggestion of scurvy was much discountenanced in our mess.

2471. Do you think that had a doctor been with the travelling parties, he would have been of assistance in meeting the first outbreak of the disease. I ask this because several officers in charge of sledge parties told the Committee that they did not recognize the disease at first, and that they had no instructions as to how to meet and remedy the first symptom?—I think that a doctor would undoubtedly have diagnosed the disease earlier, but, with the appliances at hand, I question whether he could have done more.

2472. Are you of opinion that if lime juice had been taken on those journeys, the disease would have shown itself with less virulence?—Yes.

2473. Of that you have no doubt?—No.

2474. Did you remark whether the men, who were called temperance men, were more or less susceptible to attacks of scurvy?—The numbers were so few that I regarded any deduction as unjustifiable.

2475. Speaking of the use of rum and tea side by

side, to which do you give the preference?—To tea, undoubtedly.

2476. And what would you say with regard to tobacco?—I consider tobacco altogether injurious.

2477. Either taken by smoking or chewing?—Either; I am not sure we had any chewing.

2478. Do you smoke yourself?—No; but rarely.

2479. Was bread baked on board the ship very often?—I think we always had a sufficient quantity of bread to enable us to have bread every day.

2480. Can you give any reason for saying that you think tobacco injurious?—None but the familiar ones.

2481. Have you any spontaneous information that you can give us, independently of the questions which have been put to you, which will afford the Committee assistance on the subject of the inquiry on which it is engaged?—I think that every point upon which I would have suggested spontaneous information has been referred to.

2482. (*Chairman.*) Assuming that a daily allowance of lime juice could have been administered to the sledge parties, are you of opinion that the outbreak of scurvy would have been delayed?—I think so. I think that we should have had less risk of scurvy; but it is possible that the symptoms of slight scurvy might have appeared when the men were first placed under the new conditions of sledging, and would have disappeared when they got accustomed to those conditions.

2483. Are you further of opinion that it might, or would have been entirely averted?—It might; but I do not think it would have been entirely averted.

2484. In such a case, what daily allowance would you recommend?—If I could carry it, an ounce a day would not be too much.

2485. Can you suggest any mode in which lime juice can be carried so as to admit of its being conveniently used under the temperature incident to the spring journeys from the "Alert"?—I have thought over the subject, but I do not see any way in which we could have carried lime juice under the circumstances.

2486. Then, with the means at your disposal on board the ship, you consider that lime juice could not have been melted and used under the low temperature that I have adverted to?—No, not in quantities useful in a diet scale.

2487. We have it in evidence from Captain Markham that he melted lime juice sufficient in quantity for two or three men by placing a quart bottle of it between his legs when in his bed bag at the close of the day's journey. Assuming a daily allowance for each man to be supplied separately, are you of opinion that the mode described presents a practical method of overcoming the difficulty occasioned by the freezing of the lime juice?—I think any method by which the supply of lime juice could be so subdivided would render it unnecessary to melt the lime juice at all, and it could be put into the tea.

2488. If so, in what way would you recommend the lime juice to be packed?—I have thought over the subject, and do not see any way in which it could have been carried.

2489. Have you any ground for supposing that from the natural anxiety to get through as much travelling as possible, the day's sledge journeys at first made were longer than those which subsequent experience proved to be expedient?—In the journeys that came under my experience rather the reverse was the case.

2490. Were you entirely satisfied with the equipment of the "Alert" for the special service on which she was engaged?—In the other parts of my evidence I have spoken of alterations in the diet scheme, especially the inclusion of a larger quantity of fruit. I have also referred to the details of warming and ventilation which, in my opinion, would be advisable.

2491. Did you use snow shoes on your journey, or would they have been of service to you?—Yes; I think snow shoes are occasionally most useful

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as enabling the officer exploring or leading to travel over a much greater distance than he could otherwise possibly accomplish.

2492. What description of snow shoe would you recommend?—The Western North American, pointed and turned up at the point.

2493. Can you furnish to the Committee, for those sledge journeys in which you were in command, the returns which follow (for which the forms will be supplied to you by the Secretary)—*first*, a Meteorological Return; *secondly*, a Return of the Sledge Work; and, *thirdly*, a Return of the Distance Travelled?—Yes, I will furnish them.

2494. (*Dr. Donnet.*) I would ask your opinion whether sugar adds to the value of the lime juice

as an antiscorbutic, seeing that Americans consider molasses in the light of an antiscorbutic?—I think that molasses would have been a very useful addition to our diet, but I do not think that sugar would increase its antiscorbutic powers, but it is advisable as an addition to the lime juice to render it more palatable.

2496. Do you suppose that lime juice taken alone without sugar would prove so valuable as with?—The sugar makes it more palatable, and less likely to be evaded.

2497. Were lime juice so prepared in capsules and swallowed as such, would it prove of like value if mixed with sugar?—I think that pure lime juice swallowed in capsules would be most injurious.

The witness withdrew.

BELGRAVE NINNIS, Esq., M.D., Fleet-Surgeon, R.N., *examined.*

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Fleet-Surg.,
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2498. (*Chairman.*) On what day did you join the "Discovery"?—On the 15th of April, the day she was commissioned.

2499. Did you belong to her till she was paid off?—I did.

2500. Enumerate the sledge journeys in which you were personally engaged?—I was only away once, and that was for two days to discover an overland route between our winter quarters and a bay about 7 or 8 miles distant to the northward.

2501. (*Dr. Fraser.*) Your time therefore was chiefly spent on board ship?—It was.

2502. During the winter of 1875, were there any sledge excursions from the "Discovery"?—During the winter, no; in the autumn there were some few.

2503. Did the men return from those expeditions in winter and autumn in good health?—Yes, in good health with the exception of two or three slight frost bites.

2504. Were they prolonged expeditions, or for about what time did they last?—I think the longest was about ten days. I was not in any of them, except the one I have mentioned.

2505. Do you remember whether they were dog-sledge expeditions?—Both dog-sledge and man-sledge.

2506. I believe you were the principal medical officer of the "Discovery"?—I was.

2507. What was the original number of her crew on leaving this country?—58.

2508. Did that include officers?—Yes, all told.

2509. That number was afterwards diminished, was it not?—It was first increased by the addition of an Esquimaux, and we embarked another man from the "Valorous," before she left us at Disco, making 60.

2510. Then after that time what was the number?—After arriving in winter quarters in August, seven men and an officer left the ship and embarked in the "Alert."

2511. So that your total number in winter and subsequently would be 52?—Yes.

2512. Had those 52 men good health until spring?—Very good health until the 1st of January or the beginning of the year, when I had my first case of scurvy.

2513. Who was that man?—The cooper, James Shepherd.

2514. Was he a man with whose physical and general personal character you had been satisfied?—He was a man who was pronounced unfit on leaving England, or rather during the examination by the medical surveying officers.

2515. On what grounds, do you know?—I was present, but I was not one of the Board. So far as I remember it was that he was over the age, and there was a history of pneumonia. If I remember rightly he had been in hospital for a month or six weeks some time previously to his joining the "Discovery," but that was quite sufficient for the Medical Board to pronounce against and refuse him.

2516. Why had he been in hospital?—With pneumonia.

2517. Had he been employed as a cooper until his illness on board ship?—Yes, on board the "Discovery"; and likewise he had been employed to assist the ship's steward in the hold.

2518. Was he a steady man so far as you know?—I had no personal reason to know to the contrary, but merely from hearsay.

2519. What, may I ask, had you heard?—That he was a man who, previously to joining the ship, had lived a very free life, and had been in the habit of indulging in liquor; but of course this is simply hearsay. I knew nothing of it personally. He appeared to be a strong man when he joined.

2520. And until the appearance of the symptoms of scurvy while he was under your observation was his health good?—I think, so far as my memory serves me, that he had been under treatment once or twice for colic, or something of that kind; but they were only trifling things.

2521. What food did he take while on board ship?—The men were all served the same; they had the same diet; he was a petty officer, and he would have the same as the others.

2522. You do not know, do you, if he was in the habit of not taking any of his food?—Of course I can only speak as a matter of hearsay, but I made the inquiry on his first presenting himself at the sick berth, and I was told that he was not in the habit of taking his preserved meat, as he did not like it; but whether that was true or not I cannot say; I believe it to be true, but I cannot prove it.

2523. Were the vegetables that were served, served separately from the meat or along with it?—That is a matter of detail which I am not acquainted with. So much was served out every day, but whether it was served with the meat or not I do not know.

2524. Had it been served with the meat, and had he not taken the meat, he would not have taken the usual quantity of vegetables, I suppose?—Some of the ration consists of meat and vegetables mixed, and some of it was in the form of solid preserved meat, if I may use the expression; and, under the latter circumstances, of course, the vegetables would be served separately.

2525. You do not know whether he did not take the vegetables that were served?—No, I do not.

2526. Who could give us information upon that point?—I should think that he would be the only man that could do it. I asked him about it, and he said he did take the vegetables; but he was not strictly to be relied on.

2527. Then you suspected that he did not?—I suspected that he took his vegetables, but I had very good reason to believe from enquiry that he did not take the preserved meat.

2528. Have you any doubt that he took the usual allowance of lime juice?—No, none whatever.

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2529. You know that he did?—I have no doubt that he took his proper allowance of lime juice.

2530. Do you know that he did?—I have no doubt that he did, but I did not know positively, because I did not see him drink it; but I have no doubt that he took it from the precautions taken that everybody, should take it, and, likewise, from the relish with which the men took it, and would have liked more.

2531. From this time until spring I believe you had no great expedition, had you?—Nothing, until the end of March, I think, or some time in March.

2532. With the exception of this man were you perfectly satisfied with the health of your crew until March?—Perfectly. I think that everybody was in thoroughly good health; in fact, I am sure of it.

2533. They had not apparently suffered much from the deprivation of light?—Excepting that when the sun appeared you could see that everybody was more or less anæmic, but otherwise they were cheerful and strong.

2534. You of course had the best means of judging of the health of the men because they would come, would they not, under your care?—Yes, constantly, every day, and an inspection every Sunday, in fact the usual man-of-war routine.

2535. Do you think that the general hygienic conditions on board ship were perfectly satisfactory?—There were points that might have been better, such as a larger supply of fresh air, and arresting the dripping and constant wetness that there was between the decks, these two things particularly, needed alteration, but otherwise I think they were satisfactory.

2536. Are you able to tell us what space was allowed per man for living and sleeping in?—Something under 200 cubic feet per man, in the lower deck.

2537. Was the ventilation of this space quite satisfactory?—Not quite.

2538. Why not?—The difficulties appeared to be insurmountable.

2539. I do not refer to the difficulties, but to the conditions which really existed—in what respects was the ventilation not satisfactory?—The place was very hot at times and cold at other times, and the accumulation of carbonic acid varied too; and then as the doors were opened there was a great influx or out-pouring of steam, or air which took the form of steam, which rendered everything near it exceedingly wet.

2540. Do you say that the amount of carbonic acid was too large?—It varied considerably at times. I had weekly examinations in my ship throughout the winter.

2541. Can you furnish the Committee with the results of those weekly examinations?—Yes, I could do so: I have not them with me, but they appear in my journal. (Appendix 21).

2542. Did your examinations include estimations of the carbonic acid outside of the ship?—They did.

2543. And will you include those in your returns?—There are references made to both these things in my professional journal which I am now preparing.

2544. In the meantime can you tell us what was the general result of your examination of carbonic acid?—I think, speaking from memory, that the extremes were something over 56 per cent. to about 30.

2545. Do you mean that these were the lowest and the highest extremes?—I think about that between decks.

2546. You found it practically impossible to do away with the large amount of impurity exhibited by these figures, did you?—Practically, it appeared to me impossible. We had altered the up-takes and the down-takes, and re-arranged the stoves, and did everything in that way, but it appeared to be much the same. I must tell you that the amount of carbonic acid was taken in the evening at 11 o'clock, when the men had been in their hammocks for about two hours.

2547. What was the smallest quantity of carbonic acid that you found?—I cannot call to mind, but I should think that 30 would be about it, at that time.

2548. Was the impurity represented by these figures perceptible to the senses at all?—No, the deck was very close, but nothing more than that of the sleeping deck in ordinary ships.

2549. I presume that the great difficulty which you had in improving the condition of the air was due to the fact of the very great coldness of the external air, which prevented a sufficient renewal of the air to remove the impurity, and at the same time to avoid draughts?—That was so.

2550. If you could have admitted any air from the outside and warmed it previously to its introduction between decks, could this renewal of the air not have been increased?—Yes, I think so undoubtedly with advantage.

2551. Did you make any observations in reference to the weights of the men at different times?—I did.

2552. And with what general results?—The general result was a falling off after sledging, but I must tell you that of course those were merely comparative weights. I could not strip the men we will say and weigh them, because I should have been doing what I should not have considered right, but I noted the clothes they wore and made them put the same on again when they came back, and then made a comparison of the weights.

2553. Do I understand you that generally speaking there was no loss until after the sledging began?—I started with weighing them when I left England, or rather Ireland, and we did it again on arrival in Ireland on our return, but in the meantime when the parties went away sledging I weighed them before they went in the way I am now telling you, and likewise on their return. These are the only experiments that I made as regards the weights.

2554. You are not able are you to tell us if there was any change in weight after the winter spent on board?—I am not.

2555. You of course found from what you have told me that the scale of victualling on board ship was a perfectly satisfactory one?—Yes, undoubtedly.

2556. Certainly judging from the facts which you have mentioned to the Committee, it succeeded in maintaining the men in a healthy condition?—Yes, but I must say that our men had a great deal of fresh meat in addition to the ordinary rations.

2557. Do you mean game?—Musk oxen.

2558. Was that throughout the time that you were connected with the "Discovery," or at certain periods?—I think from the time of our going into winter quarters, in August, to the beginning of November, and then we had a few days at Christmas time of English mutton, and then again after Christmas in the new year we had some more; but I cannot exactly call to mind the number of days per week.

2559. After the first case of scurvy, to which you have referred, can you inform the Committee which was your next case?—I do not think I had another until May.

2560. What case was that?—That was the case of Alfred Hindle, on the 19th of May.

2561. How had he been employed immediately previous to his illness?—He had been sledging.

2562. On what expedition?—To the north coast of Greenland. All our men that were attacked with scurvy were over there.

2563. Did he come under your care along with other cases?—He did.

2564. What cases?—Edward Taws, James Cooper, and Jeremiah Rourke.

2565. Those were all unmistakable cases of scurvy?—Yes.

2566. And all from the same expedition?—Yes.

2567. Which were your next cases?—My next cases were Michael O'Regan and Frank Chatell; those occurred on the 15th July.

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2568. How had they been employed before they came under your care?—Sledging.

2569. Then they came under your care already affected with scurvy?—Yes; as they came on board on their arrival from the expedition, they were affected with it.

2570. Which expedition was this?—I am not sure about Chatell, but I know that O'Regan had been with the North Greenland party.

2571. Which were your next cases?—The next case that arrived was William Jenkins; that was on the 4th of August.

2572. How had William Jenkins been employed?—Sledging.

2573. Do you remember which expedition?—The same one—the North Greenland expedition.

2574. After William Jenkins what case came under your care?—Frank Jones.

2575. On what date?—The 8th of August.

2576. Had he been in the same expedition?—Yes, the same expedition.

2577. Which was the next case?—The next case was Peter Craig.

2578. On what date did he come under you?—On the 15th of August.

2579. What had been his employment immediately previously?—Sledging on the same station.

2580. Which was the case after that of Peter Craig?—Wilson Dobing—both on the same day, the 15th August. I should say that these were the last that were treated by me.

2581. They were not the last that were treated in the "Discovery," were they?—The last that were treated in the "Discovery," but Dr. Coppinger treated, I think, eleven or several of them besides those at Polaris Bay, and they were quite cured when they came on board afterwards.

2582. Can you tell us how many men of the 52 who constituted the crew of the "Discovery" at the commencement of 1876 were attacked with scurvy?—10 of the 52. Our crew was 60 at this time and all the time that we were away. The eight previously mentioned were only lent to the "Alert," but they appear on my sick list. Our men, as I stated just now, were embarked in the "Alert," where they stopped during the winter, but, when the sledging season came round they left the "Alert" and were under our officers sledging. It was during the period that they were thus engaged, and, therefore, really belonging to us that they got ill; these men did not come back to the ship to me until they were well, because they were treated by Dr. Coppinger at Polaris Bay.

2583. Then of the 60 men who constituted the crew of the "Discovery" how many were attacked with scurvy?—16.

2584. That is to say five more than you have mentioned to the Committee?—There were 16 men who were attacked with scurvy and three of them had a relapse after being apparently cured at Polaris Bay. Requiring to cross Robeson Channel, about 40 miles, to join the "Discovery," they had a relapse, and they required further treatment on board.

2585. So that I understand that you had in all 16 cases out of 60, of which one only occurred previously to the spring sledging expeditions?—That is so.

2586. How do you account for this great discrepancy in the number of cases in the spring compared with the single case that occurred in the winter, seeing that so far as the season was concerned, the winter season was probably the more trying one?—The cold was more intense in the spring than in the winter, and of course the men were suffering from the effects of the winter, likewise from a longer deprivation of vegetable and animal food; and they had likewise been longer subjected to the absence of the sun, and the ordinary daylight exercises in the open air, and so on; and, in addition to all this, they had had the excessive labour of sledge travelling and dragging those sledges.

2587. This, in your opinion, accounts for the discrepancy?—Yes.

2588. You cannot refer it to any difference in the diet?—Their diet, so far as I know, was the same throughout the winter, and it was, to all intents and purposes, the same all the time that we were on board ship up to the time that the sledges went away.

2589. Those cases did not occur on board ship?—They did not.

2590. Do you still adhere to the answer that the diet was essentially the same?—The diet was essentially the same.

2591. In the case of those men who were affected, and in the case of the crew during the winter, it was the same?—I understood that we were talking now about the time at which the cases occurred, which was in the spring, and the time at which the cases did not occur, which was in the winter. As I said, the diet throughout the winter was virtually the same as it was all the time the men were on board the ship.

2592. The diet on board ship may have been the same in spring and in winter, and still the diet of the sledging parties, I need scarcely point out, may have been different from that of winter?—Quite so; the diet of the sledging parties was widely different, but there was one case on board the ship in winter.

2593. That is the case which I allude to as constituting the discrepancy which we had already fully discussed as I understood; what were the important differences between the dietary of the sledging parties and the dietary on board ship both in winter and in spring?—Substituting pemmican for preserved meat and fresh meat, and omitting lime juice and beer; I think that is all the material difference.

2594. The diet for the sledging parties was therefore a very different one I think from that on board ship?—Yes.

2595. Have you any opinion to offer as to the influence of the differences which you have named upon the production of scurvy in the cases in spring?—The absence of fresh meat undoubtedly would make a difference; the presence of lime juice would not in my opinion have prevented the outbreak of scurvy in all cases, but most probably would have modified the character of it; but this is merely an opinion.

2596. The fresh meat being absent, do you mean to say that the scurvy resulted as a consequence?—I think that the presence of fresh meat in sufficient quantity would have prevented the occurrence of scurvy, under certain conditions.

2597. What conditions?—That the men were not subjected to the extreme labour that they underwent.

2598. Then it would not have prevented it in those sledging expeditions where the men were subjected to extreme labour?—Possibly not.

2599. Have you known any cases in which fresh meat has prevented an outbreak of scurvy, or on what do you found the opinion that it might possibly in this instance have prevented it?—I had had experience of scurvy on a former occasion where we did not have any lime juice in the ship, and where the scurvy did not appear until the men were on short allowance of provisions.

2600. When was this?—I am speaking from memory, but I think it was in 1864 or 1865.

2601. In what ship, and where were you then serving?—I was surveying in a small schooner on the northern coast of Australia.

2602. On such duty, I apprehend, you occasionally, if not frequently, landed, did you not?—Frequently.

2603. Did you receive any supplies of food whatever on landing?—Constantly.

2604. What?—Plenty of birds; but we used to take away with us a litter of pigs, so that we should have fresh meat for many months as those animals grew up.

2605. I would prefer in the meantime that you would restrict your answer to the occasions on which you landed; during your duties on the survey, what provisions did you obtain?—The place was uninhabited, so that we could get nothing except what

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was shot; there were the ordinary birds, parrots, paroquets, wild ducks, curlew, quail, besides kangaroo, and things of that kind.

2606. Did you obtain any vegetables?—Not at that time.

2607. How long were you employed in this service?—Nearly three years.

2608. All the time off the coast of Australia?—Yes, all the time in Australia.

2609. And during all this time do I understand you to say you never obtained any vegetables?—No; I am alluding now to the time at which the scurvy broke out.

2610. I am referring to the whole cruise?—That cruise was extended over about ten months, in which we got the scurvy; and that occurred, as I was saying, after we had expended almost all the animal food that we had in the ship, and likewise what we could get from the shore.

2611. Previously to the outbreak, what vegetable food were you supplied with?—Little or nothing. It is a long time ago to tax my memory, but it was our custom there when we left to take as many potatoes as we could with us, and these would last for some weeks possibly.

2612. It was upon one of the cruises which lasted ten months, you say, that this occurrence took place?—Yes; I think about ten months.

2613. How many cases of scurvy occurred at this time on board the ship on which you were?—Three.

2614. And do I understand you to say that they occurred shortly after your stock of provisions became disagreeably small?—When we were on reduced allowance of all things; and in some of them we were almost entirely deficient.

2615. In what were you almost entirely deficient?—I think flour was very scarce with us at this time.

2616. What flesh had you?—Preserved meat, of Dutch manufacture I believe, spiced, and the usual salt pork and beef.

2617. You have no doubt, have you, that these cases were cases of scurvy?—No doubt whatever.

2618. What had been the vegetable food previously to the occurrence of these three cases?—As far as I can remember there must have been no vegetable for some weeks previously.

2619. You appear to have only an indistinct recollection of the events, I think?—Of the detailed events I have not, it was so many years ago, in 1864.

2620. Excuse my asking you, but may I ask what age you were at that time?—I am now 39, and I should be 27 then.

2621. Were you the principal medical officer of the ship?—I was the principal and only medical officer.

2622. Have you retained any record of these occurrences?—I am afraid not. The ship was not a Royal Navy ship, she was conjointly under the colonial and imperial Governments, and the men were not Royal Navy men.

2623. What was the name of the ship?—The "Beatrice."

2624. From where was she commissioned?—She was owned conjointly between the Imperial and South Australian Governments, she was fitted at Adelaide, South Australia.

2625. Previous to the three cases occurring, your stock of vegetables, whatever those were, had to a great extent failed, I think you say?—For some weeks the vegetables had failed I think entirely, and the provisions of the ship had failed, so that everybody was on reduced allowance.

2626. You were subsisting chiefly on meat, I think you said?—There was preserved meat and pork and such like things.

2627. And at the same time you were having rations of lime juice issued, were you not?—No, we had no lime juice in the ship.

2628. Then it is not a case which proves the inefficiency of lime juice?—No, I brought it up rather to say that men could work as well if they had plenty

of fresh food, because directly I got them plenty of fresh food and such vegetables as I could about the country, all the men recovered.

2629. The opinion that you have now expressed is in accordance with, I may almost say, the general opinion of authorities upon the subject, is it not?—Exactly, I believe so.

2630. That vegetable food is not only a preventative of scurvy, but also a most useful remedy in the treatment of scurvy?—But there was a large supply of meat, that was the point I was bearing upon.

2631. I wish to ask you if you have not told me that the three cases of scurvy which occurred in this previous experience of yours did occur after your stock of fresh vegetables had failed, and while the main support of your crew was meat?—A very little meat, and that of an inferior quality.

2632. What other food were you having at the time?—Very little of anything; a reduced allowance of everything.

2633. Then I am not perhaps wrong in having said that your main support consisted of meat?—It is so long ago that I cannot tell you what the ration was, or what the proportion of meat to rice was, or what the proportion of meat was to anything else, but as far as I can remember the meat was reduced to about one-half.

2634. You wish from this illustration to point attention to what effect?—To the effect that we were forced to give up the work, and take the men to a hunting ground that we knew of, where we knew there was buffalo to be shot, of which they used to eat as much as ever they chose; and at the same time I discovered some cabbage palms, which they likewise partook of.

2635. In the narrative, therefore, which you have favoured the Committee with, there does not appear to be any decided weight of evidence in favour of the fresh meat over the fresh vegetables, does there?—The fresh meat was unlimited, and the fresh vegetables was very limited.

2636. You probably, from what you have just said, are not aware that in the presence of unlimited supplies of good fresh meat, and the total absence of fresh succulent vegetables, scurvy has on several very prominent occasions occurred?—Undoubtedly, I am acquainted with that.

2637. Then you do not mean to say, do you, that fresh meat in itself will protect a person from attacks of scurvy?—Fresh meat in itself may not protect from or prevent the occurrence of scurvy under all circumstances, but I think under the majority of circumstances it would, particularly if there is any great physical exertion being used.

2638. Do you know of any case in which it has done what you suppose it can do?—I am not acquainted with any.

2639. I have already mentioned some incidents to a previous witness bearing upon this point, and I think I shall ask you also to listen to one. During the Crimean War the French troops were fed on fresh meat several times a-week, and they had rice, but no fresh succulent vegetables nor lime juice. Scurvy broke out during the winter of 1854-5. During spring, the returning vegetation afforded an abundant supply of vegetable food, and the scurvy diminished. During summer, and the hottest month probably, the ground became parched, vegetation disappeared, no fresh vegetables could be obtained, rations of lime juice were not issued, and the outbreak of scurvy reappeared. During all these successive changes there had been a supply of fresh meat. Do not you think that such a case somewhat strongly points to the conclusion that fresh meat is not able to prevent an outbreak of scurvy?—The evidence is exceedingly strong.

2640. Without going further into that matter, I would simply say that there are many other cases recorded of as strong a kind, and I would now ask you whether with such facts it is still your opinion that fresh meat may prevent an outbreak of scurvy?

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—I am not prepared to give an opinion with such powerful evidence against me as you have just now advanced, without considering the matter longer than I could detain you at present. I have spoken from experience in the North, and likewise in Australia, and I consider that I have arrived at a tenable conclusion, but the character of what you have stated to me is undoubtedly very strong.

2641. But your Australian experience did not appear to me to be at all satisfactory as a proof of the power of fresh meat alone to prevent scurvy?—It appeared to me at the time to be the only thing which prevented the men from getting ill, as we were working exceedingly hard, and the amount of vegetables always a minimum; I am not entering into controversy, I am merely stating my impressions at the time.

2642. What vegetables were supplied to the sledge parties?—The sledging ration was changed more than once. I have not the sledge rations in my memory, but I believe two ounces of potatoes per man were allowed.

2643. Was this potato in a dry form?—Edwards's preserved potato in a granular form.

2644. Not a succulent vegetable?—No.

2645. You also had no lime juice in those sledging parties?—I was not away with them. I believe they had not any; they certainly had not on the only occasion that I was on one.

2646. Had you expressed an opinion previous to the starting of those sledge parties, respecting the desirability of carrying lime juice or not?—I had.

2647. What opinion?—That it was an advisable thing to do; that the men would be better if they had it: or much to that effect.

2648. In your treatment of the cases that came under your charge what general course did you follow?—Almost entirely attending to the diet, giving such nutritious food as one had, substituting wine for rum, or beer for wine if we had it, as occasion presented itself; also lime juice, preserved fruits, jams, milk, these were matters of diet; and I tried citrate of potash as a medicine. Mustard and cress were supplied on eleven occasions to all the crew, and to the sick they were supplied every day from early in June until we left our winter quarters on our return to England which was at the end of August.

2649. Did all your cases recover?—There were two deaths.

2650. How long had those two men been ill before they came under medical care?—Neither of them was under my care at all, but the second one was under medical treatment for three or four days before he died.

2651. How long had this second man been affected before he came under medical care?—Something a little over a month I think. As I stated before he was not under my care, and I did not see him at all during the whole of his illness, so that I am merely speaking from what was reported to me.

2652. So far as you know how long were the other men (I mean those who recovered) ill, generally speaking, before they came under medical care?—From a month to six or seven days.

2653. Were there many in whom the interval was a month?—I think two were about a month.

2654. Then the second case which you referred to as having terminated fatally was among those in which the interval between the commencement of the disease and the date of treatment was about the longest?—He was ill on the 6th of May, and he died on the 3rd of June, so that he was ill for less than a month.

2655. But were they the only two cases ill for about a month?—The fatal cases were ill for about a month, and there were also two others, so that if you take the two deaths there were four.

2656. Then there were four cases ill for about a month before coming under medical care, of which two died, and two recovered?—Yes.

2657. And those two deaths constituted the only

deaths among your sixteen cases?—Yes, those were the only deaths.

2658. As soon as the cases came under medical care, did they receive lime juice?—Immediately.

2659. What do you consider is the great obstacle to the carrying of lime juice in the sledge parties?—The weight of the lime juice itself, the weight of the fuel necessary to thaw it, and likewise to thaw the water in which to take it.

2660. Would it be much of a gain could the weight of the lime juice be diminished by the removal of about 80 or 90 per cent. of the inert matter, that is to say, the water?—Of course; you would require more water to be thawed to make it serviceable.

2661. Still, the weight to be carried would be diminished, I understand from your answer?—The weight of the lime juice would be diminished, but you would have to carry an increase of fuel to thaw more water.

2662. That is only in the coldest season, I think?—Yes; in the coldest seasons.

2663. This lime juice however might be diluted with some of the water which you have necessarily thawed, might it not?—My personal experience of sledging is that there is no more water ever thawed than is absolutely required for the occasion, and I do not know, but I presume that the fuel is proportionate to that quantity only.

2664. It has been suggested that it might be mixed in tea; taking it as granted that it is very important to administer lime juice, do you think this a feasible scheme?—I have tasted tea with lime juice in it and it is not very palatable, but I think that it would so cool the tea that it would be disagreeable, and you would lose one of the advantages of the warm tea if it were rendered cold by this introduction of frozen lime juice.

2665. Supposing it were very important to carry this, some other method of administering it no doubt could be discovered?—Yes, I should think that some method might be discovered of doing it.

2666. There does not appear to you to be much obstacle in the way of discovering some method of reducing its weight, which seems the great difficulty about it?—No, undoubtedly not.

2667. Some process of condensation such as I have just referred to, similar to that of condensed milk, might indeed be adopted?—I should think so, to lessen the weight.

2668.—Could you give us generally any explanation of the fact that the crew of the "Discovery" was affected with scurvy to a very much less extent than the crew of the "Alert"?—I have always put it down to the amount of fresh meat which we consumed in the "Discovery" in excess of that consumed on board the "Alert."

2669. But your cases of scurvy did not occur as I understand while you were consuming fresh meat, did they?—They did not.

2670.—Do you still hold this opinion?—I do, until I have had time to think over this matter.

2671. The quantity of fresh meat obtained by the crew of the "Discovery" was very much greater than that obtained by the crew of the "Alert"?—A great deal more.

2672. About how much?—I should think three times up to the period I am alluding to now; up to the end of the winter.

2673. But you had only one case of scurvy I think up to the end of the winter?—Quite true.

2674. How many cases are you aware had within that time broken out in the "Alert"?—None, that I am aware of.

2675. Then the greater abundance of fresh meat in the "Discovery" was, so far as the facts you have stated are concerned, a cause of scurvy, and not a protection from scurvy?—I do not look upon it in that light.

2676. Can you explain why you look upon it in another light?—I have never heard the theory advanced that the presence of fresh meat in the way

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we are talking about it now, would have produced scurvy.

2677. I do not say that it would, but I say that the facts which you have stated point to the conclusion, that if fresh meat had any influence upon the production of scurvy, it increased rather than diminished that production?—I look upon it that the consumption of fresh meat on board the "Discovery" during the winter enabled our men to set about their work in a much better condition in the spring, and thereby prevented their breaking down with the scurvy to the extent that the "Alert's" men did; this merely is an opinion, of course.

2678. On what do you found that opinion?—Merely that it was the only appreciable difference in the diet between the two ships; the work, I believe, as far as I could gather, was much the same.

2679. You found the opinion therefore merely on the fact that you had less scurvy than the "Alert's" crew had?—We had less scurvy than the "Alert's" crew had. As far as I know, our men did the same work, and the only way to account for it, as far as I could see, was in the difference in the food during that winter.

2680. You are, perhaps, aware that the crew of the "Alert" at the end of the winter, previous to the spring expeditions, was very carefully examined by the medical officers?—That was so, I am told.

2681. And to their entire satisfaction, with the health of their crew?—Yes.

2682. And further they have told us under examination that they then, with one or two exceptions, could detect no deterioration of health or of physical power whatever in the crew; do you think this supports your opinion that the greater supply of fresh meat to the crew of the "Discovery" had benefited them so far as their physical powers are concerned to any appreciable extent?—I cannot pretend to say how it is that the fresh meat acts, but it is my opinion that our exemption was mainly due to that extra consumption of fresh meat—that is my firm impression at the present time.

2683. (*Dr. Donnet.*) Although there are difficulties under which arctic ships labour with regard to ventilation, I would like to have your opinion as a medical officer whether you consider their state in this respect as perfect as it could possibly be made?—No. I should suggest that the upper deck including the hatchways should be enclosed in a snow wall, roofed over so as to leave sufficient space for ordinary exercise. The space thus enclosed being cut off from the outer air, free communication could be kept up with the lower deck by removing the hatchways, and thereby increasing the cubic space of air occupied by the crew.

2684. In fact it would be a superior substitute for the present housing?—Yes.

2685. Do you think that the system of warming by the distribution of stoves over the various parts of the deck could be improved?—I do not; but I think that the improvement adopted in the "Discovery" with the galley would be useful on a future occasion, that is, that a kind of inverted funnel was put over the whole of the galley, by means of this the draught was increased and the smell and steam of the cooking was carried directly away instead of permeating the lower deck. This was independent of the chimney.

2686. Did this improvement tend to decrease the moisture of the atmosphere on the living deck?—I do not think it did, but the smell of the cooking was undoubtedly less.

2687. Did you make any observation regarding the quantity of ozone on the living deck?—No, not on the living deck; we did in the open air.

2688. You were one of the medical officers, were you not in the examination of the men made in April 1875?—I was at the examination, but not on the board.

2689. Were you satisfied with the health of your men when they joined your ship?—Undoubtedly. I was quite satisfied.

2690. Did you find any advantage in the blue jackets over the marines as sledge travellers?—It never struck me, but I see there was only one marine that had scurvy.

2691. What was the proportion of marines to blue jackets, and the proportion of men affected with scurvy amongst the marines to those amongst the blue jackets?—I have not gone into that question as yet; but that information will be found in the journal which I am now preparing.

2692. With regard to the selection of men, would you prefer men of florid complexion and sanguine temperament to men of a lymphatic temperament?—The majority of our men were fair as regards their complexion (I have the per centages here), but as regards their temperament I have not had an opportunity of judging. I think 40 (drawing an arbitrary line between fair and dark) were what I considered fair, and the remainder dark.

2693. In the selection of men for arctic service, would you prefer total abstainers to men of moderate habits?—The experience of total abstainers with us was so very limited, there being only one in my ship, that there is not sufficient ground to go upon; but I think that the quantity of spirit which is procurable on board is certainly not enough to materially affect any constitution.

2694. I think you said that your complement was 60, whilst that of the "Alert" was under 70; on board of the last ship 38 was the number of scurvy cases, whilst the number in the "Discovery" was 16; was the larger number of cases in the "Alert" due to their more northern position and to the influences which reigned there, such as absence of light and greater cold?—I explained just now my opinion of the reason why we had so very many cases less than on board the "Alert," namely, owing to our having had more fresh meat during the winter. I should think the "Alert's" exposed position, with the increase of anxiety of the extended darkness might possibly have had some influence in increasing the number of cases of scurvy.

2695. In the treatment of your scurvy cases did lime juice form a part?—A very essential part.

2696. What quantity did you administer to each man daily?—From two to eight ounces.

2697. Was the larger amount of eight ounces taken readily?—Very readily.

2698. In what way did you administer it?—In water, two ounces of lime juice to the half-pint, I think. It was in strong doses, of course, and the reason for that was that if I had given it in a more diluted condition the amount of fluid taken in the course of the day would have been excessive.

2699. Was this administration marked with good effects?—Yes.

2700. Did they recover more rapidly after the exhibition of lime juice?—As the lime juice only formed part of the ration and of the treatment of the sick it would be very difficult to put the beneficial effects of the treatment down to any particular article; but it is my impression that it was most beneficial.

2701. You have said that fresh meat and vegetables in the instance which you quoted in the surveying expedition in Australia, proved remarkable in their curative powers; did you attribute those powers to the meat or to the vegetables?—I attributed it to the meat, inasmuch as some of the men would take enormous quantities of meat, whereas the cabbage palm was not a very great favourite as an article of diet.

2702. From the experience which you have had in Her Majesty's service generally, are you of opinion that a prolonged abstinence from, and deprivation of vegetable juices, will induce scurvy?—I have no doubt of it.

2703. Do you consider that prolonged abstinence from vegetable juices is an essential cause of scurvy?—Yes.

2704. Do you consider that lime juice is a good

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substitute for other vegetable juices?—The best substitute that we have; but, in my opinion lime juice is very much inferior to fresh vegetables.

2705. Had you the responsibility of dieting a sledge party would not lime juice form a part of the ration?—After the experience already gained I consider that it ought always to be taken on sledge journeys.

2706. Do you consider it the best prophylactic that can be taken?—I do.

2707. Have you any suggestions to offer as to the mode of carrying lime juice?—I think that the suggestion of Dr. Fraser just now of condensing it might be very useful.

2708. Do you by “condensation” mean that you reduce it very much in bulk?—That would be a question for experiment.

2709. Do you think that the citric acid which it contains is the active element which produces its preventative powers?—I have no experience on that subject.

2710. I would ask you whether you have any suggestions to make towards an improvement in the diet supplied to arctic ships, referring more especially to condensed milk, fruits, pickles, compressed vegetables or other matters which you may have considered?—I should suggest that salt beef should not be taken; there should be a reduced quantity of very good pork and the ration made up of preserved meat, mutton or beef, not those made up dishes like collops and those kinds of things; that an increased quantity of peas should be supplied for peas pudding; that the quantity of rum should be reduced, and the space utilized in carrying tea or a larger quantity of condensed milk.

2711. Do you think that fatty matter, such as butter and cocoa might prove a useful addition to this diet?—I consider that butter and cheese would be a most valuable addition.

2712. You expressed an opinion that the rum should be reduced and the tea increased. What is your opinion as to the relative properties of each?—I made that suggestion, not so much because I consider that the ration of rum is excessive, but that the space saved by making a very small reduction in the amount of rum would leave a very large space which could be conveniently put to the use of carrying tea; and, as far as my experience goes in the arctic regions, tea is always a most welcome beverage.

2713. In your own sledging experience, did you find that the men worked better after tea than they did after spirits?—I sledged in the autumn, at which time the mid-day beverage was rum, and not tea; tea was not adopted until the spring.

2714. Did you find the men work better after the luncheon than they did before?—No, no better than they would do, I think, after an ordinary halt of twenty minutes.

2715. Do you think that this arose from any bad effects of the rum which they had taken?—I think not. It must be borne in mind that if the halt is for rum, it is only for perhaps ten minutes or a quarter-of-an-hour, but if it is for tea it is an hour or an hour-and-a-half sometimes.

2716. Do you attribute the benefit that arises from the taking of tea to the greater length of the halt?—I think that that has something to do with it, but I can answer for the comforting effects of warm tea, even when you are not sledging, in preference to rum.

2717. We have it in evidence from several witnesses that tea proved superior to rum when taken at luncheon—do you concur with them in that opinion?—I do concur with it, but my personal experience does not extend so far as that. I am merely speaking from hearsay; but I think from what I can hear, undoubtedly it is preferable to rum.

2718. I would like to hear your opinion again of the causes which operated to produce this outbreak of scurvy?—The absence of fresh vegetables and of

fresh meat; the absence of lime juice, the cold and the excessive fatigue.

2719. (*Admiral Inglefield.*) Did you give instructions to the officers in command of the sledge parties with reference to the symptoms of scurvy and how to meet them?—I did not.

2720. During the winter months was it never a subject of conversation amongst you as to those symptoms, and the possibility of their breaking out whilst they were absent from the ship, and away from the assistance of the medical officers?—The subject of scurvy was more than once under discussion, but merely in reference to the case which was on board; but the occurrence of scurvy in a sledge party, so far as I know, never presented itself to the mind of anybody.

2721. Then the medical instructions which were issued to the commanders of the sledge parties had only for their object the possibility of casualties and ordinary maladies, such as constipation and diarrhoea?—That is all.

2722. Did you recommend that the sledging parties should take lime juice with them?—I discussed the question with Captain Stephenson, but I did not urge it as a point of vital importance.

2723. But with your present information you would not hesitate now to press it as a necessity?—I should not.

2724. In what way would you otherwise alter the diet carried by the sledging parties?—I have not given that subject consideration. There did not strike me at the moment any way in which it could be done.

2725. You think that the mixing of the ration of lime juice with the tea would not be very unpalatable, and would be quite worthy of experiment considering the advantages of the fuel which would be necessary for melting the water to mix with the lime juice being thereby saved?—I have tried lime juice in tea, not in the arctic regions, but in other places, and I can quite understand that lime juice would be very unpalatable in it if put in in any quantity, and as regards the feasibility of thawing the lime juice in the tea, and thereby saving fuel, I think that that is a question which would have to be tried, as I do not think that the warmth of the tea would be sufficient to thaw the quantity of lime juice required at one time.

2726. We have been told that the quantity of lime juice given as a ration to each man would not be more than the size of a bantam's egg; if the lime juice could be divided into portions, and packed as it was the fashion in former times to prepare the materials that oil painters used, in bladders tied together at the point, and the mixture taken out by perforating it with a pin or a needle, could not the lime juice so packed have been melted by each man for his day's consumption by placing it in his night-bag or in some convenient position during his sledging journey, and thus the necessity for detracting so much from the heat of the tea entirely obviated?—Undoubtedly that is worth experiment. It appears very feasible, either to carry it about the body or to put it in the bed bag; but at the same time we found that when the men carried their water bottles with the water in them inside the waistband of their trousers, even in that position the water was frozen in the bottles in the course of an hour or so.

2727. That may be perfectly true, and I know from experience that it is so; but the quantity is a great deal larger than that which would be required if the lime juice were carried as is suggested?—Yes, certainly.

2728. Have you at all considered the question of acclimatization, and whether men who have experienced the rigours of an arctic winter without great exertion would not be better adapted to undertake so long a journey, than those who were started, after they had first experienced a winter, upon a journey of extraordinary length and difficulty?—I think that if we could put the men in the same state

of health with fresh meat and vegetables prior to starting on a second year's sledging, the experience that they had formerly gained would assist them so much as to enable them to do a great deal more work in the second spring than they did in the first.

2729. Is it your opinion that the compressed tea is an improvement upon the tea served in the ordinary form?—I have no experience in that tea—I did not try it.

2730. Generally you have a decided opinion that tea is preferable to rum?—Yes, during the working hours.

2731. But that the grog is beneficial after work is over?—I think from my own experience that the grog after one has turned into one's bag at night, and just before going to sleep, produces a glow, which makes you start asleep, warm from the effects of the grog, and that glow is kept up by the thickness of the clothes that you are sleeping in; I think it is useful in that way.

2732. Have you at all considered, and can you give the Committee any opinion as to the advantages or disadvantages of the use of tobacco, either by smoking or chewing?—My own experience in smoking is, that in the open air it tends to lessen one's inclination or ability for work; but I had no experience with the sledge crews. The difficulties of keeping a pipe alight in the open air in the Arctic are very great. I have had mine freeze on my way to the shore, only a little more than a hundred yards off.

2733. Finally, can you give the Committee any information with regard to the subject of this enquiry which has not been elicited from you by the questions already put?—I think that all I have to say upon the matter has been elicited by the questions which have been put to me.

2734. (*Chairman.*) Assuming that a daily allowance of lime juice could have been administered to the sledge parties, are you of opinion that the outbreak of scurvy would have been delayed?—I think that if lime juice had been administered to each man during his sledging, the outbreak of scurvy very likely would have been delayed and many cases might have been prevented, and the remainder modified in character. I have no experience, but what I am stating now is merely an opinion which I have formed from seeing the effects, or the apparent effects of lime juice on men who have been under treatment.

2735. Are you further of opinion that it might or would have been averted?—I do not think that the administration of lime juice would altogether have averted the outbreak of scurvy amongst the sledge parties.

2736. In such a case, what daily allowance of lime juice would you recommend?—One ounce.

2737. Have you any ground for supposing that from a natural anxiety to get through as much

travelling as possible, the daily sledge journeys at first made were longer than those which subsequent experience proved to have been expedient?—My personal experience of sledge travelling is, as I have stated before, very limited; but I have no reason to suppose that it was the case.

2738. Were you entirely satisfied with the equipment of the "Discovery" for the especial service in which she was engaged?—I was satisfied with the exception of those few alterations which I have already specified, and I think they would be advisable. I should likewise wish to add a suggestion or two, that is that light frames, merely the glass part of the frames I mean, such as are used for cucumber frames, should be taken out, and I have no doubt that with these you could grow mustard and cress, and lettuces, and onions, and those kind of things, which could be grown in very considerable quantities as soon as the weather begins to get reasonably warm; because, with my limited space I could grow very large supplies, inasmuch as I sowed a square yard, and then in a week's time I sowed another one, and so on, as the one grew up the other one was coming on; and directly it was finished I set more, and so on. I grew some of the "Polaris" wheat in that place, and some celery and beans. I likewise grew some mustard and cress in the open air in July. There was another thing which I thought would be useful, which is, that besides mustard and cress being taken, they should take lettuce and onion seed, and things of that kind. As regards medicines for the sledge journeys, I should suggest, as I suggested in one of my reports, that they should be put up and sent away in the form of capsules or something of the kind, instead of necessitating weighty bottles; bottles are exceedingly heavy. Every thing must be put into bottles, and if the corks get lost there is a great deal of trouble with them.

2739. (*Dr. Donnet.*) Was not the experiment you allude to, namely the growth of wheat, the only one that we have of wheat growing and becoming developed after an exposure to extreme cold for four years?—I believe so, every seed so far as I could see was thoroughly sound.

2740. (*Admiral Inglefield.*) Did you try peas in the same way?—I did, and they grew equally well, and the beans that we took out for the pigeons also.

2741. (*Chairman.*) Can you furnish the following returns to the Committee: first, a copy of the medical instructions given to the officers in command of the sledge parties; and secondly, a chemical analysis of the air inside and outside of the ship?—I will furnish the first. (Appendix No. 12.) The latter one I can supply as regards the carbonic acid only, because it was merely as to the amount of carbonic acid that the examination of the air extended. (Appendix No. 21).

The witness withdrew.

Adjourned to to-morrow at 11 o'clock.

FRIDAY, 19TH JANUARY, 1877.

PRESENT:

ADMIRAL SIR JAMES HOPE, G.C.B., in the Chair.

ADMIRAL SIR R. COLLINSON, K.C.B.

VICE-ADMIRAL E. A. INGLEFIELD, C.B., F.R.S.

JAMES J. L. DONNET, ESQ., M.D., Inspector-General of Hospitals and Fleets, R.N.

THOMAS R. FRASER, ESQ., M.D., F.R.S.E.

H. J. VANSITTART NEALE, ESQ., Secretary.

RICHARD WILLIAM COPPINGER, ESQ., M.D., Staff Surgeon, R.N., *examined.*

2742. (*The Chairman.*) On what day did you join the "Discovery"?—On the 15th April, 1875.

2743. Did you belong to her till she was paid off?—Yes.

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2744. Enumerate the sledge journeys in which you were personally engaged?—Lieutenant Archer's expedition to Polaris Bay; Lieutenant Beaumont's North Greenland exploring expedition; and Lieutenant Fulford's Petermann Fiord expedition.

2745. (*Dr Fraser.*) You had, I understand, under your care several of the cases of scurvy which occurred in connection with the crew of the "Discovery," had you not?—Yes.

2746. I would trouble you to enumerate those cases and the dates on which they occurred, commencing with the first one that came under your immediate care?—Charles William Paul (A.B.); his illness began on the 19th of May.

2747. And how had he been employed immediately previously to the 19th of May?—He had been sledge travelling with Lieutenant Beaumont.

2748. He became ill, did he, during this sledge travelling?—Yes; he came under my care on the 25th of June, and on the same date William Jenkins, carpenter's mate; the latter had been ill from the 16th of May.

2749. How had William Jenkins been employed previously to the 16th of May?—On the same duties as the previous one, sledge travelling with Lieutenant Beaumont. On the same date Peter Craig (A.B.); his illness began on the 16th of May; he had also been employed sledge travelling with Lieutenant Beaumont. Wilson Dobing, gunner in the marine artillery; his illness began on the 21st of May; he came under my care on the same date, 25th of June; he had been employed sledge travelling with the others with Lieutenant Beaumont. The next was Alexander Gray, ice-quartermaster; his illness began on the 19th of June, also; he was one of Lieutenant Beaumont's sledge crew. Frank Jones, stoker, was the next case; his illness began on the 19th of May; he came under my observation on the 25th of June; he had been previously employed on Lieutenant Beaumont's expedition. The next case was Lieutenant Beaumont; his illness began on the 23rd of June, and he came under my observation on the 25th. Those are the men of Lieutenant Beaumont's party. Of Lieutenant Rawson's party, whom I met at Polaris Bay on the 7th of June, there was George Bryant, captain of the maintop; he had been ill from the 11th of May. Michael O'Regan (A.B.) also had been ill from the 3rd of June.

2750. Had you more from the same party?—No; only those two. At this time the dead body of Hand was there also; he had belonged to this party. Among Lieutenant Fulford's party, there was Frank Chatell, captain of the forecastle; his illness dated from the 22nd of May; he was under observation from the same date. Those are all the cases that came under my care from those expeditions.

2751. Constituting 11 cases, I think?—Yes; 11 cases.

2752. Besides those 11 cases, how many others occurred in the crew of the "Discovery"?—Five.

2753. So that there were 16 cases of scurvy in connection with this ship?—Yes.

2754. And can you also inform us what was the total number of officers and men in the "Discovery"?—During the winter the number was 52, eight of the crew having been transferred previously to the "Alert."

2755. Sixty being the full strength?—Yes; 60 was the full strength.

2756. And those 16 cases I think included some of the eight men who had been transferred to the "Alert"?—Yes.

2757. So that out of the total strength of 60 belonging to the "Discovery" there were in all 16 cases?—Exactly.

2758. And what was the termination of those 11 cases?—Two deaths, nine recoveries.

2759. I think you yourself accompanied, did you not, some of the expeditions from the "Discovery"?—Yes.

2760. Did scurvy occur in all the expeditions which you accompanied?—No.

2761. In which of them?—The only cases of scurvy which occurred under my observation when sledging were in Lieutenant Fulford's expedition to Petermann Fiord.

2762. Was this a long expedition, either in distance or time?—No.

2763. How long was it?—Estimating the start from Polaris Bay, where I joined the expedition, it began on the 22nd of May, and terminated on the 7th of June, that is, considering Polaris Bay as the base from which it started, and to which it returned.

2764. Lieutenant Beaumont's expedition was a much more prolonged one, was it not?—It was.

2765. And the majority of the cases which you have enumerated occurred in Lieutenant Beaumont's expedition, I think?—Yes.

2766. Can you remember what was the original strength of Lieutenant Beaumont's expedition?—On leaving the "Alert" his party consisted of 24, that being the entire strength of the party.

2767. And of those 24 can you remember how many were attacked with scurvy?—Ten.

2768. Were there any deaths among these ten?—Two.

2769. In fact, the two deaths which occurred were in this most extended party?—Yes.

2770. In the expeditions in which you yourself took part, did you carry lime juice, or any substitute?—On two occasions, when accompanying the sledge expeditions, I carried lime juice, but not as part of the regular ration.

2771. Do you mean that you did not carry a sufficient quantity to issue a regular ration?—Quite so.

2772. For what purpose did you carry it?—On the first occasion I carried it for the treatment of Frank Chatell, the seaman whom I have mentioned as suffering from scurvy.

2773. That was in Lieutenant Fulford's expedition, I think?—Yes.

2774. And on the second occasion?—On the second occasion I carried it for the use of Lieutenant Beaumont's sick, when accompanying Lieutenant Rawson on a short sledge expedition in search of Lieutenant Beaumont's party.

2775. And while you accompanied Lieutenant Beaumont's party, was a regular ration issued of lime juice?—While stationed at Polaris Bay, whilst travelling from the point where we met Lieutenant Beaumont's party suffering with scurvy, and until we reached Polaris Bay, and subsequently, during the time of our stay at Polaris Bay, it formed part of the regular ration.

2776. Not immediately on leaving the ship, do you mean?—No.

2777. How many days interval was there in which no lime juice was issued?—From the 20th of April until the 25th of June, as regards Lieutenant Beaumont's sledge crew.

2778. This man, Chatell, recovered, I think?—Yes.

2779. Was his illness a long one?—His illness began on the 22nd of May; it was never of a serious nature, and he was quite well on the 28th of June.

2780. It was not a serious case, and its duration, judging by your experience in other cases, was not a long one?—Considering the mildness of the symptoms, I considered it long and tedious.

2781. Were you able to give him rest immediately on the occurrence of scurvy, or did he continue moving or travelling about?—He continued travelling.

2782. Then the condition was not favourable to an immediate or speedy recovery, however efficacious the remedies you might have employed were?—I considered it was; the work on which he was employed was exceptionally light; he was part of the Petermann Fiord expedition. On starting from Polaris Bay on this occasion, a dog-sledge was used; there was no traction by men. His duties simply com-

prised walking with the sledge, or riding on the sledge.

2783. Do you mean after he became ill?—Yes.

2784. You quite agree with me, do you not, that in cases of scurvy an important point is to secure perfect rest?—Yes, under certain circumstances.

2785. If you yourself had entire control of the circumstances perfect rest would be what you would endeavour to obtain, is it not; of course putting aside any slight exercise which the patient may be able to take?—Yes; and I consider that the exercise which he had then was of a healthy nature, so slight was it.

2786. This case, however, did not occur while a ration of lime juice was being issued, I think I understood you to say?—The ration had not been issued for any considerable time previously. He had had, at broken periods, the ration of lime juice.

2787. During this expedition?—He had, during this expedition, lime juice regularly.

2788. Previous to his illness?—No; not previous to his illness, but at broken periods previous to his illness.

2789. Could you give us a little further detail as to what you mean by broken periods previous to the 22nd of May?—He left the "Discovery" about the 10th of May, having previously been receiving a ration of lime juice. He reached Polaris Bay about the 14th of May, and from that date until the 17th he had a ration of lime juice. He then left Polaris Bay, and after four days returned; he then had one day's ration of lime juice. On the 22nd of May, the following day, he showed signs of scurvy, and from that date until about the 28th of May he had a daily ration of lime juice.

2790. Previously to the 22nd of May, on which date I think you have told us his illness commenced, there had been an interval in the first place of four days, during which he received no lime juice, from the 10th to the 14th; then he had received lime juice from the 14th to the 17th, that is to say, for three days, and then he had no lime juice for four days, that is, up to the 21st; and then he had during one day a ration of lime juice, and on the following day he became ill; was that the history of the case?—Yes.

2791. Judging from the history which you have given us, what is your opinion as to the sufficiency of the quantity of lime juice which this man got between the 10th of May and the 22nd of May, so far as the preventative powers of lime juice are concerned?—I do not consider it a test case by any means.

2792. You consider, do you, that the administration was not effected in the most advantageous manner for the best action of the preventative?—Certainly the outbreak of scurvy was not prevented by the administration of lime juice, such as it was; whether the scurvy arose from the fact of the lime juice not being in sufficient quantity, I do not think there is evidence upon which to form an opinion of any value.

2793. Is it your usual custom, when you administer lime juice as a preventative, to administer it daily, or would you recommend such administration in preference to an interrupted administration?—Certainly, I should recommend a daily administration.

2794. This, then, was not a daily administration?—No.

2795. Therefore it was not, in your opinion, so good as a daily administration?—No.

2796. Why was the lime juice carried on those two expeditions?—On the first occasion it was carried, because this man Frank Chatell showed signs of scurvy.

2797. When did he show signs of scurvy?—On the 22nd of May.

2798. When did you add lime juice to your equipment?—On the same date.

2799. Before passing from that subject, the Committee would like to have the advantage of knowing from you, what were the leading symptoms that you observed in the cases under your care?—Great debility, dyspnoea, on slight exertion, stiffness and

pain in the muscles of the legs and back, soreness of the gums, looseness of the teeth, petechiæ and ecchymotic patches on the extremities, sallow complexion, loss of appetite, desponding state of mind, and lassitude.

2800. Did you notice if there were any pains similar to those of rheumatism at the earliest stages of the disease?—Yes.

2801. Do you mean fugitive pains, as they are generally termed?—Yes, but not specially of that character; but I recollect one case in which the pains were of a fugitive nature.

2802. And were those pains among the very earliest symptoms?—In one case the pains, which seemed to have arisen from a strain and were rather of a continuous character, appeared as an early symptom, or might be considered, I think, as an early symptom of the disease. On the second occasion when I noticed fugitive pains, the symptom was a late one in the course of the disease.

2803. I know that your opportunities of making any refined observations were necessarily extremely restricted?—Yes.

2804. But it would be so interesting that I cannot refrain from asking you whether any examination was made of the urine in any of those cases, and if so, what examination?—I frequently examined the urine as to its ordinary physical characters, examining it in a bottle, and I also tested for the presence of albumen by boiling; that was the only test which I had at hand.

2805. Are you able to give the result of those examinations to the Committee?—Yes. I found no indications of the presence of albumen from the one test of boiling the urine; that, of course, was not a conclusive one. A peculiarity of the urine in some cases was, that on being exposed in a bottle in the sun for about half an hour it became exceedingly turbid; the urine in most cases was of an unusually dark reddish colour, not smoky, and without deposit. The quantity voided, I was informed, by the men previous to their coming under my observation, had been exceptionally small.

2806. That is in the early stages of the disease?—During the course of the disease. The last remark specially alludes to the time when the men were being carried on the sledges.

2807. You of course had no opportunity to test the acidity of the urine?—No, unfortunately I had not.

2808. In your treatment of those cases can you tell us the general system which you adopted?—In all the cases, with the exception of that of Chatell, rest was enjoined. Their daily treatment consisted in the administration of lime juice and molasses, fresh meat of various kinds, seal meat, wild fowl, musk-ox flesh, preserved meat, farina, kidney-sorrel, biscuit, and pea-soup: those were the internal remedies. In the later stages I applied externally turpentine liniment to the neighbourhood of the knee joints.

2809. The results of this treatment were, from what you have already told us, satisfactory, were they not?—Yes.

2810. When speaking of the symptoms, I forgot to ask you whether diarrhoea was observed as a frequent symptom, or a symptom in any cases?—In no case was diarrhoea observed.

2811. Were there any swellings in the neighbourhood of the joints?—During the convalescence of one of the patients that came under my observation, there were swellings in the neighbourhood of the ankle joints.

2812. Were there any discharges of blood from any of the mucous passages?—On one occasion epistaxis occurred, and occasionally blood to a small extent, that is, a few drops, came from the gums; in no other case was there any flow of blood observed.

2813. Was ulceration present as a symptom?—Ulceration of the gums only.

2814. I feel sure that you could not have had sufficient opportunity to make the observations I now ask you about, but, in the event of your having done

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so, it would be very interesting to know what the results were; were any observations made on the temperature during these cases?—Yes.

2815. And with what general result?—In four cases there was an elevation of the temperature above the normal standard for a considerable time; and it subsequently declined, just as in the case of a fever.

2816. Were these uncomplicated cases, I mean without any chest disease or other acute affections?—In two of these cases there was chest affection.

2817. I should be much obliged if you would favour the Committee with your opinion as to the cause of all the cases of scurvy to which you have alluded?—I do not think I have got sufficient evidence before me to certify as to the precise cause of the outbreak, and in default of that, I must attribute it to a combination of causes. I think that the length of the dark winter, and the great cold experienced had a deteriorating effect upon the constitution of the men, which predisposed them to attacks of disease, and that, while employed in sledge travelling, the very severe nature of the work, and the absence of fresh vegetable and animal food were the exciting causes.

2818. The two causes which you have mentioned as predisposing, acted, did they not, simply by reducing the standard of health, and so increasing the liability to any disease; is that what you mean by your answer?—Yes, but especially to diseases of this class.

2819. These two causes may occur separately, I suppose, or even in combination, without scurvy being a necessary consequence; is that also what you mean?—Yes.

2820. The severe work of sledge travelling, which, I believe, was almost unprecedented, need not either have been followed as a necessary consequence by scurvy, need it?—No.

2821. Then it may, perhaps with propriety, be included among the predisposing causes, which you have already mentioned as operating by reducing the standard of health?—It may; it is however a technical difference.

2822. Then the immediate exciting causes, in your opinion, were the absence of fresh vegetable food, and of fresh animal food, is that so?—Yes.

2823. To which of these two causes do you assign the first importance?—I do not think that I have got sufficient evidence on which to base a reliable opinion as to that.

2824. You do not know, perhaps, that in the presence of an abundance of fresh animal food scurvy may occur?—I am aware that cases are reported of scurvy having occurred among persons who had an abundance of fresh animal food.

2825. Then can the absence of fresh animal food be an immediate or exciting cause?—I do not consider the fact that there are inexistence records of cases of scurvy having occurred where men had fresh animal food is a proof that fresh animal food may not be a preventive. There may have been some other cause. I do not consider that it points to the necessary conclusion that the absence of fresh meat may not be a cause of scurvy under certain circumstances.

2826. I wish to ask you to consider the difference between a cause which operates in conjunction with numerous cases, so as to be a predisposing cause of, but by no means a necessary antecedent to a disease, and a cause which is an exciting cause, and therefore a necessary antecedent; bearing in mind this distinction, do you still think that the absence of fresh animal food is an exciting cause or a necessary antecedent of scurvy?—I do not consider that the absence of fresh animal food is a necessary antecedent to scurvy.

2827. You have mentioned that the absence of fresh vegetable food was in this outbreak of scurvy in your opinion one of the exciting causes?—Yes.

2828. Do you mean by that, that had fresh vegetable food been supplied, or any efficient substitute for fresh vegetable food, the outbreak could or would not have occurred?—I have already stated that in

assigning causes for this outbreak of scurvy, I consider that I have not sufficient evidence upon which to base a definite opinion as to the precise cause.

2829. Do you know of any outbreak of scurvy in which there was a sufficiency of fresh vegetable food, or of some efficient vegetable substitute?—It is reported to have occurred in Russia, among certain of the inhabitants who live entirely upon a fresh vegetable diet.

2830. Can you favour the Committee with a reference to the record?—It is mentioned in some of the text books of medicine; I think in Niemeyer's text book, and I think also in Russel Reynolds' Practice of Medicine.

2831. Still you think it important, do you not, that either fresh vegetables, or some efficient substitute, should be included in a dietary where the conditions are such that an outbreak of scurvy might occur?—I do, unquestionably.

2832. At the end of the winter season, and before any extended expeditions were sent from the "Discovery," was the health of the crew of the "Discovery" satisfactory?—It was in general.

2833. Whatever influence the absence of light and the confinement of the crew might have had upon their health, it did not produce very marked effects upon their health, did it?—No.

2834. Did it produce any effects which were so obvious as to draw your attention to them?—Except in the case of one man. One man of the crew suffered from scurvy during the winter; that was Shepherd.

2835. He became ill, I think, upon the 1st of January, did he not?—Yes.

2836. This was the only case in which obvious effects were noticed after the prolonged winter?—Yes.

2837. You do not, however, mean to say, do you, that the absence of light or the confinement on board ship were the causes of the scurvy in this case?—I think that they must be considered at least predisposing causes.

2838. But can any disease occur for the causation of which both exciting causes and predisposing causes are necessary, in the presence only of the predisposing causes?—What may be a predisposing cause in a disease may, at other times, technically be considered an exciting cause.

2839. In the same disease?—In the same or other diseases.

2840. We are talking of one disease, and of the predisposing and exciting cause of that one disease; if that one disease has both predisposing and exciting causes, could that disease occur in the absence of the exciting cause, and in the presence only of the predisposing cause?—It could not occur without the exciting cause, but that exciting cause may have escaped observation.

2841. This man was employed on board ship as a cooper; do you know from your own knowledge whether he took his full ship's dietary immediately before the 1st of January?—Not from actual observation of my own. My knowledge as to the way in which he partook of the ship's dietary, is derived from enquiries made and information obtained from reliable sources.

2842. What was the result of that enquiry?—I heard that he had not invariably taken the vegetable portion of his dietary.

2843. What effect had that information upon your mind, when attempting to account for the appearance of this case?—That it was not an important feature among the causes.

2844. Have you not already told us that among the exciting causes of scurvy, and, as I understand you in your subsequent examination further to say, among the most important exciting causes of scurvy, is the absence of fresh vegetable food?—I have said just now that he had not always taken the vegetable food, and from careful enquiries which I instituted as to that point, I considered that there was not evidence to show that he had, on any great number of occasions,

omitted to take his vegetable food; but, on the contrary, I understood that he had only on some few occasions omitted to take it, so that I did not consider it of importance.

2845. You did not consider it of importance that he should have omitted it on a few occasions, and your information is only positive that he did omit it on only few occasions?—What I wished to convey was, that, from the information which I obtained as to the number of times he had omitted to take his vegetable food, I did not consider that I could attribute the outbreak to that at all; the number of occasions were so few, and I enquired particularly carefully into the matter.

2846. For what reason had he omitted to take his vegetables on any occasion?—Disinclination.

2847. He was disinclined to eat vegetables?—Not in general, but on some occasions he did not take them from disinclination. I wish it to be clearly understood that he did not habitually neglect to take his vegetable food.

2848. And he was not a man whom you would suspect to conceal anything, was he?—No.

2849. Was his moral character very satisfactory?—Yes, it was good.

2850. Still there were certain occasions antecedent to the occurrence of his illness, in which you had reason to believe, from information derived by enquiry, that he did not take his vegetable food?—Quite so.

2851. While you were wintering in the "Discovery," can you tell us if any and what special duties were assigned to you respecting the sanitary arrangements on board ship?—I had none directly bearing on the sanitary regulations of the ship, but, under Dr. Ninnis's directions, I took estimations of the carbonic acid in the air between decks.

2852. And of the air outside also, I think, that is to say in the open air?—Yes.

2853. Did you examine the drinking water on any occasions chemically, sufficiently to satisfy yourself as to its quality?—Yes, not quantitatively.

2854. It would have been marvellous, considering the work you had to do and the extremely unfavourable conditions in which you were placed, if you were able to undertake any refined chemical work, and more especially any quantitative analysis?—We were precluded from taking quantitative analysis of water as regards chlorine, from the absence of any apparatus suitable for the purpose on board; we were not supplied in the "Discovery" with an apparatus for the estimation of chlorine.

2855. What process did you find most convenient to adopt in estimating the carbonic acid in the air?—Pettenkofer's process with baryta water.

2856. Your object was to gauge the purity of the air, was it not?—My object was simply to ascertain the amount of carbonic acid present in the air under certain circumstances.

2857. That is usually done, is it not, in order to have an idea of the purity or impurity of that air?—It certainly is sometimes done with that purpose.

2858. Your object was not that, was it?—My principal object was to ascertain simply the fact as to the amount of carbonic acid present in the air under certain circumstances.

2859. You can, from such indications, obtain an idea, can you not, of the purity, or otherwise, of the atmosphere?—Certainly; to a great extent.

2860. Are you able to tell the Committee what was the air-space per head in the sleeping and living portions of the ship, both in the officers' and in the men's apartments?—In the men's sleeping apartment, the lower deck, it was 140 cubic feet per head, if I remember rightly.

2861. Is that deducting the space occupied by the furniture and by the bodies of the men?—Yes.

2862. That is the clear space?—Yes, the clear net air space.

2863. This 140 cubic feet per head comprised the

space used for sleeping, and to a considerable extent, did it not, for living also?—Yes.

2864. Do you recollect whether it is the case that in order to maintain sufficient purity of air it is necessary to supply at least 3,000 cubic feet per head, per hour?—I am aware that such is stated on authority.

2865. With an air space of 140 cubic feet per head, how frequently would the air require to be renewed in order to supply 3,000 cubic feet per head?—Between 21 and 22 times.

2866. Do you recollect whether it is not the case that even at the ordinary temperature of this climate, if the air be renewed so often as six times in the hour, the inconvenience resulting from cold and draught is almost unbearable?—I am aware that such is laid down on authority.

2867. Then it would have been much more difficult in the cold climate in which you wintered to have renewed that air six times than it would be in this country?—Yes.

2868. And probably it would have been almost impossible to renew it so often as twenty times, which appears to have been the frequency required in order to maintain a pure atmosphere?—Yes; that is, accepting a certain standard of purity laid down by authorities who recommend that space.

2869. So that you would naturally imagine that the air between decks could not have been pure in the "Discovery," accepting these standards?—Accepting these standards, I would consider it impure air.

2870. Was the result of your estimations of carbonic acid in support of the assumption that it was impure, or can you give us the general results of your estimations?—The results certainly showed that, as regards the standard of pure air which has been laid down by many authorities, the air in our lower deck was impure.

2871. We have had some details on that point from a previous witness, but I should like to ask you what the quantity of carbonic acid between decks was?—Before giving any details as to that, I should like to state that the observations which I made have never since been revised; that is to say, I have never gone over the calculations since early in the spring, when I ceased to take them, and that I am not certain as to the accuracy of the results, but premising that, I can say that the average percentage by volume on the lower deck during October, November, and December, was .46 per cent. at 11 o'clock at night.

2872. At that hour the atmosphere would be in about the worst state, would it not?—Yes; I consider that about the worst time.

2873. What was the best result that you obtained, so far as purity is concerned, that is to say, the least carbonic acid?—I could not say from memory; the above fact I recollect, because I have stated it in my journal for the year 1875.

2874. That is the average maximum impurity, as I understand you?—Yes; in that sense. About the same time I took observations as to the amount of carbonic acid in the external air for the sake of comparison.

2875. Can you inform us as to the general results of these latter estimations?—They showed an enormous quantity in the external air, the amount ranging from .07 per cent., I think, to .1 per cent.; certainly about that.

2876. We have not had these facts from any previous witness, and of course they very much modify any opinion that might have been before arrived at?—That is why I say that I do not bind myself to the accuracy of the results, because they are so strange, until I verify them.

2877. Can you supply the Committee with the exact analysis to which you refer?—It is in Dr. Ninnis's possession. (Appendix No. 21).

2878. You noticed no obvious sensible impurity, did you, in the atmosphere of the ship, I mean obvious to the sense of smell?—No; that is a remarkable fact, the organic impurity seemed not to be great, as judged by the senses.

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2879. Can you tell us if among your observations on the physical condition of the men, you included periodical weighing?—Yes, at intervals of very long periods; the regular periodical monthly examination did not include weighing, but the men were weighed at long intervals.

2880. About what intervals?—They were weighed at the time of leaving England, and again before they started sledging in the early spring.

2881. Can you favour the Committee with a report on these weighings, or can Dr. Ninnis do so?—Dr. Ninnis has got those papers. The general result seemed to be an increase of weight at the end of the winter.

2882. That is to say, the general result was an increase of weight before the sledging parties started?—Yes.

2883. Was there no weighing after that at all?—Yes, they were weighed when they returned from sledging.

2884. Have you had any opportunity at any time of examining the lime juice which was supplied?—I have not.

2885. You can tell us nothing as to the effects of cold upon the lime juice, can you?—Not as to the effects of cold upon the lime juice supplied to the ship. I wish to draw a distinction between the lime juice supplied to the ship and the lime juice which we used at Polaris Bay. The lime juice which we used at Polaris Bay was part of the stores of the American expedition, and it was of a different quality from ours.

2886. I understand that that lime juice had been five years at Polaris Bay, is that so?—Yes.

2887. Can you describe how it had been kept all that time?—It had been lying in casks placed in the open.

2888. Were those casks covered?—They were amongst a pile of similar stores, boxes of preserved meat, casks of pork, and so on.

2889. This lime juice must of necessity have been subjected to very low temperatures, and to very high temperatures, during the five years?—Yes.

2890. That was the lime juice, was it not, which you used in the treatment of a number of cases at Polaris Bay?—Yes.

2891. How many cases were there?—Eleven.

2892. Was this lime juice used in the treatment of all the eleven cases?—Yes.

2893. You have had, therefore, ample opportunity, have you not, of judging of its quality?—Yes.

2894. What is your opinion on that subject?—I think it was good.

2895. It seemed to you to favour the recovery of the cases of scurvy under your care, did it?—It did.

2896. Have you had any experience of any other lime juice except this lime juice?—Yes.

2897. Are you prepared to say that it was equally efficient with any other lime juice of which you have had experience?—I had experience of the progress of Shepherd's case, which occurred during the winter, when he received the navy lime juice; and on this point, the only evidence that I can give is, that no material improvement occurred in his case for a considerable time after he had been taking the navy lime juice; and that on the men who were sick at Polaris Bay, and who were treated with the American lime juice, it seemed to act favourably in the way of promoting their recovery. This fact, of course, is not of any material value as a proof of the superiority of the one over the other.

2898. Can you describe the physical condition of this lime juice at Polaris Bay?—When I first saw it, it was frozen. The cask was lying upon its side. The upper layers consisted of transparent ice, with an occasional thread of pulpy matter, and this upper stratum seemed to consist almost entirely of water; it contained very little of the essential character of lime juice; but the lower layers consisted almost entirely of very stringy pulp, apparently the pulp of the fruit, and was consequently of very much greater

strength. In taking the supply of this lime juice while in a frozen state, we took the pulpy portion, entirely avoiding the watery part. The lime juice in this condition we used during the Petermann Fiord expedition. Subsequently, on or about the 15th of June, the lime juice melted; at first, the upper portion, the watery portion, and finally, it all having melted, we stirred it up, and then it became of uniform strength. It was of a darker colour than the navy lime juice, and not so translucent, containing strings of pulp.

2899. Did you make any endeavour to discover whether crystallisation had taken place in the frozen lime juice; that is to say, in the lower portion, as you have described it?—I did not observe any; it seemed to be frozen in one mass, the lower portion of which consisted of pulp.

2900. This lime juice in Polaris Bay was subjected to very low temperatures, no doubt?—Yes.

2901. Was it subjected to high temperatures during the five years?—Of course, I cannot say as to the temperatures during the five years which it lay there, but judging from the temperature of the summer which I spent at Polaris Bay, I should say that the highest temperature did not exceed +40; but being exposed during a part of that time to the direct rays of the sun, the temperature may have been higher. The temperature which I have named, +40, is the temperature taken in the shade.

2902. From the position of the casks they would necessarily be exposed, would they not, to the full sunlight?—Yes, during the summer which we spent there.

2903. In the treatment of a number of those cases, I understand you to say that you used merely the sediment at the bottom of the casks, that is, the more pulpy portion; the upper portion consisting of the watery constituents of lime juice?—Yes.

2904. And you found that the watery portion having been removed from the other, the remainder, which you did use, was perfectly efficient?—Yes.

2905. Do you think it might be possible, if an objection to the use of lime juice on such expeditions is its weight, to condense this lime juice by the abstraction of the water at such a temperature as experience shows to be a safe one, and to add sugar in such proportion as would otherwise have been necessary in administering the lime juice, so as to obtain a preparation in some respects analogous to an ordinary extract, and perhaps even more analogous to condensed milk; that is, by the removal of the 80 or 90 per cent. of water contained in the lime juice, and, if found expedient, by the addition of sugar in the proper proportion?—I think that would be possible.

2906. Do you think that that would obviate any objection to its use in a sledging expedition?—Of course it would be a matter for experience to determine whether the lime juice would lose any of its antiscorbutic qualities from being subjected to the process, on which I cannot speak.

2907. But, judging by analogy, you are aware that many vegetable juices which are very prone to spontaneous decomposition may be preserved in the form of extract for long periods of time?—Yes.

2908. And that they retain the full physiological property of the original juice; is not that so?—In many cases.

2909. I have had occasion to refer to a book by the late Professor Parkes, and at the end of this book I find an appendix which was specially prepared by Dr. Parkes for the medical officers of the arctic expedition. It contains hints as to various observations which he thought it might be valuable that the medical officers of the arctic expedition should have undertaken, had it been possible to do so; can you inform the Committee if any of these observations were made?—The letter in question was not seen by me or my colleague Dr. Ninnis until this summer, so that, of course, no observations based upon the suggestions in that letter could be entertained.

2910. I believe that Dr. Carpenter also took the

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trouble to prepare some notes of observations which he thought would be valuable could they have been made; can you inform the Committee if those observations were made?—No, they were not made, and for a similar reason.

2911. (*Dr. Donnet.*) Referring to the knowledge you have acquired from your readings of antecedent arctic voyages and the conversations you may have had with men of experience in the arctic service, do you know whether the question of the ventilation of arctic ships is not a very difficult one; and may I add, whether the impurity, which from circumstances seems to be an unavoidable difficulty, was greater in other expeditions than in yours?—As regards the first portion of the question, I am aware that there is great difficulty, and there has always been great difficulty, in the ventilation of arctic ships, but I am not aware of the existence of any precise data as to the impurity of the air in other arctic ships.

2912. Considering the ships which are to navigate these seas, do you think that a larger space than that which you had could have been afforded. I would add that Dr. Ninnis in his evidence suggested that the upper deck above the living deck might be covered over, so as to give a larger space of air to the men, and, at the same time, to diminish the condensation; have you thought of this question, and what is your opinion?—I have thought of these matters, and I think it is impossible to provide accommodation and suitable ventilation on board an arctic ship on the same principles as ventilation can be, and is supposed to be, carried out on shore. As regards the "Discovery" in particular, I do not think that much more space could have been provided. The accommodation might have been increased by the construction of a deck house; but that, of course, would have increased the difficulty of warming, and the expenditure of fuel.

2913. From the nature of this navigation, are you of opinion that ships of larger tonnage might have been sent to those seas for arctic exploration?—My answer, of course, is not a medical one, but I think it would be inadvisable to use ships of greater tonnage, because of the difficulties of the navigation.

2914. Taking all things into consideration, do you think that the greater impurity of the air on the lower deck, compared with that of the outer air, had any direct or indirect influence upon the health of the men?—I think that it was not directly conducive to the maintenance of perfect health, but that, under the circumstances, perfect purity of air was not to be obtained.

2915. Were the experiments made by you with regard to the state of the atmosphere of the living deck taken when all the men were in their berths and asleep?—Yes.

2916. You mention in your report that the body of James Hand (A.B.), when seen by you, although dead, exhibited the characteristic marks of advanced scurvy, will you tell the Committee what those marks were?—Emaciation, extensive ecchymotic patches over the upper and lower limbs, and swelling of the gums.

2917. Were you satisfied that these marks were those of scurvy?—I was.

2918. You mention likewise that there were symptoms of effusion in the ankle joints; did you observe hydrothorax, or hydrocele, or effusion in other joints in the sick that came under the observation of the medical officers of the "Discovery" afterwards?—None in any case that came under my observation.

2919. I believe you gave seal meat to the sick after they had come under your care?—Yes.

2920. Do you know whether that possessed an equal value with the musk-ox beef?—I consider it superior to musk-ox flesh.

2921. From your experience, do you know whether the Esquimaux give a preference to seal meat over musk-ox beef?—My experience simply amounts to information obtained from the Esquimo whom we had on board, and from what I have read on the subject; I have none beyond that. It has been to this effect,

that they do attribute great value to seal meat, and more value to that than to musk-ox flesh.

2922. Is the objection to musk ox due to its peculiar smell?—I have never heard that alleged as a reason by the Esquimaux, but the seamen did on many occasions object to musk-ox flesh on account of its smell and flavour, but as a rule they liked the seal meat very much.

2923. In your two sledge expeditions you carried lime juice; was this lime juice obtained at Polaris Bay, or did you bring it with you from the ship?—It was obtained at Polaris Bay.

2924. Did you take it on your own responsibility, knowing it to be a curative, at the same time that you were about to meet men affected with scurvy?—I took it on my own responsibility as a curative agent for scurvy.

2925. I understood you to say, that you believed lime juice to possess antiscorbutic properties; do you consider that it ought to be carried in all sledge expeditions?—I certainly think it advisable, if practicable.

2926. Do you not attach great value to its use as a prophylactic, especially where men are exposed to such influences as those to which sledging parties must necessarily be exposed?—I think it would be of great value as a prophylactic to sledging parties.

2927. Did you ever discuss amongst yourselves the probability or possibility of scurvy appearing in your expedition, and, if so, what opinions did you hold at that time?—I did discuss the subject with Dr. Ninnis, as to the probability and possibility of scurvy breaking out, but it was the opinion, judging from the literature of previous arctic expeditions, that it was unlikely that it would occur.

2928. Are you aware that the greater number of the previous expeditions had scurvy, with few exceptions?—No; I am not aware of that.

2929. Have you considered the question of the diet of arctic ships, and have you any suggestions to make towards its improvement?—I should recommend an increase in the amount of vegetables supplied, and that the diet should be more varied, that wine should be substituted for rum, and that the allowance of preserved meat should be increased.

2930. To what amount?—I should increase the allowance of preserved meat to a pound and a-half per day. I should also recommend condensed milk and butter to be added to the dietary, and that the allowance of Normandy pippins should be increased to at least double.

2931. Can you tell me whether the men showed any preference for the soft bread over biscuit?—Yes; they preferred the soft bread, and generally made the allowance of flour for soft bread extend over the biscuit days.

2932. Would you do away with the biscuit, and give a larger amount of flour?—Certainly, if practicable.

2933. Have you any suggestions to offer with regard to the dietary of the arctic sledges?—I should recommend that lime juice, or some efficient preparation of lime juice, be carried as part of the daily ration, that the allowance of potatoes be increased, that dried fruits be also carried, and that spirits be omitted from the diet scheme as an unnecessary weight. I should also recommend that a large supply of medical comforts be carried, such as essence of beef, preserved milk, spirits, and so forth.

2934. In the outbreak of scurvy in your expedition you mentioned a combination of causes as predisposing and exciting; have you given thought to the supposition that influences, of which we have as yet little knowledge, such as magnetic, electric, or others, might have been at work to develop scurvy more readily during one season than another, in the same manner as yellow fever will prevail in the West Indies during some years with virulence, whilst at others it leaves the inhabitants of those Islands perfectly free?—I have considered the subject, but not in the exact light in which you put it. I have considered,

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that there might be obscure causes, influencing outbreaks of scurvy in the arctic regions, but I have been unable to determine what they were, if any.

2935. (*Admiral Inglefield.*) Had you ever seen scurvy before the instances that were exhibited in your late voyage?—Yes.

2936. Where?—In a civil hospital.

2937. Were they the result of voyages in arctic climes, or in tropical regions?—They were not the result of voyages in arctic climes, but they resulted from voyages in merchant ships. I cannot at present specify as to the particular region from which the merchant ships came.

2938. Were the symptoms in every respect the same as those which you observed on the recent voyage in the north?—I have had so little experience of scurvy, except that which came under my observation in this expedition, that I cannot draw an extensive comparison between the two at all, but in the main I see no essential difference.

2939. You have given such full details of the treatment of the men attacked with scurvy that it is unnecessary to go into this matter again. Can you, however, give any information which has not been elicited from you by previous questions?—I think I omitted to mention that preserved potato formed part of the treatment for scurvy. I might also allude to the importance of absolute rest in the treatment of serious cases; that moving the men, even from the sledge to their bags in the tent was attended with, at times, alarming paroxysms of dyspnea, and the greatest care had to be exercised in avoiding any disturbance of the body. The difficulties of performing the ordinary functions of nature were very great in the case of those who suffered severely from the disease.

2940. Have you anything further to remark upon that subject?—No; nothing occurs to me.

2941. Then I gather from your reply, that if the men, when severely attacked, could have received the comforts of quiet and repose, they would have been more readily cured than when treated on a sledging journey?—Yes; I wish to convey that the exertion to which the men were inevitably subjected when travelling acted deleteriously on their health.

2942. You mean that it aggravated the symptoms?—Yes; it aggravated the symptoms.

2943. You were present, I think, with the party when Paul died?—Yes.

2944. Have you made any statement as to the particular symptoms and manner in which the death of that man occurred, who was in the extended eastern party; and can you briefly give us an account of the manner in which death ensued, whether it can be entirely attributable to scurvy, or to a debilitated constitution?—His constitution was utterly broken down by the attack of scurvy; scurvy was the cause of his death.

2945. But otherwise he had a fair constitution?—Yes, a fair constitution.

2946. Putting tea and rum together as a portion of the diet issued to the crews of sledging parties, to which do you give the decided preference?—To tea.

2947. Do you consider that rum might be dispensed with as a portion of the provision of a sledging party?—I do.

2948. Then you mean to say that rum was by no means a necessity for the victualling of a sledging party, in your estimation?—Yes.

2249. With regard to the use of tobacco, do you consider that its use amongst the crew of a sledging party is advantageous or disadvantageous?—I have seen no evidence that led me to believe that its use was attended with any injurious effects; but I think that the allowance might be reduced; that it is unnecessarily large.

2950. It has been found that chewing tobacco was in some measure an antiscorbutic; had you any experience with regard to that?—I noticed the case of one man who chewed habitually, and who did not

suffer from scurvy; but beyond that I had no evidence of any value.

2951. Did he undertake long sledging journeys like the others?—Not of the longest nature.

2952. In your statement about the cubic space on the lower deck of that ship, it must not be lost sight of that all the men were seldom or never on the lower deck at the same time; is not that the case?—Quite so.

2953. And therefore your estimate of the number of cubic feet which is considered a fit quantity for each man must not be taken as strictly correct?—I have calculated the cubic space per head for the number of men who habitually slept between decks.

2954. And therefore not the whole ship's crew?—There was only one man on deck during the night in the winter.

2955. Was there only one man on the watch at a time?—Only one man at a time, the quartermaster. I have calculated for the actual number of men who slept in their hammocks at night.

2956. For how many months was that?—Between five and six months.

2957. But during the day, I presume, the crew were kept as much as possible off the lower deck?—Yes. That estimation does not at all apply to the amount per man during the day time.

2958. Could you give me the name of the man who chewed tobacco?—Darke, a private marine.

2959. On what journey was it that he went?—He started from the "Discovery" on the 6th of April, and returned on the 20th of May.

2960. Then that would be 45 days?—Yes; four of which days he spent in the "Alert," namely, from the 16th to the 20th of April.

2961. Have you heard of no other instance of a man chewing tobacco and his being exempt from symptoms of scurvy?—I noticed no other case of a man who habitually chewed tobacco.

2962. Have you considered at all the question of lime juice being carried in small packages, so that each man might have his day's allowance about his person, and keep it in a thawed state, ready for use with his tea or otherwise?—I think that would be almost impracticable. It was found impracticable for the men to carry water during the working hours.

2963. That I am aware of; but the water was carried in large tin bottles with gutta-percha caps, I think, and the quantity was so very much larger than the lime juice that would be required, that it hardly bears upon the question. We have had it in evidence that Captain Markham was able to put a quart bottle of lime juice between his legs in his bed-bag, and he melted a sufficient quantity for the use of four or five sick men. If each man had been supplied with the quantity usually served as a ration of lime juice, could he not have thawed it by taking it as Captain Markham did into his bag at night, and placing it between his legs?—I think that on some occasions he might have thawed it, but with great inconvenience.

2964. So small a quantity as the size of a bantam's egg?—He might have thawed the raw lime juice; but it would of course be necessary to obtain water to dilute it.

2965. Could not that quantity have then been mixed with the ration of tea in the morning?—It certainly might have been mixed with the ration of tea, but the question is, with what results.

2966. Would it have been very unpalatable, do you consider?—I think it would.

2967. Still all medicines are unpalatable, and would it not have had the effect of administering the dose of lime juice which was necessary to be taken as an antiscorbutic?—As regards the raw lime juice, it might have been thawed by that means, but of course by the abstraction of a certain amount of heat from the individual who thawed it.

2968. Have you any information which you can give the Committee as to the growing of mustard and cress and parsley, which was practised on board the

"Discovery" to some extent?—It was practised to a large extent by Dr. Ninnis during the spring and during my absence. I had seen it grown to some extent while I was on board; but it was grown to a large extent during my absence, so much so that it became a ration.

2969. Had it been a well organised system on board both ships; might you not have grown a sufficient quantity to keep the ship's crew more or less constantly supplied with some green food?—During the summer time it might have been so.

2970. Do you attribute the outbreak of scurvy principally to the lengthened darkness, the extreme cold, and extreme fatigue combined, or to any special one of these three causes apart from the others?—I attribute it to a combination of causes, as I have not got sufficient evidence to determine precisely any actual single cause.

2971. Have you formed any opinion as to the possibility of men being acclimatised to the arctic regions, and so being less susceptible to attack of scurvy, which in the case of the last expedition was so very marked and peculiar: that is to say, if the men had spent a winter in the arctic regions first without excessive fatigue, in the following season would they have been less subject to this outbreak of scurvy than they were in the course of the first winter?—I do not think they would have been less subject to an outbreak during the second year.

2972. To what do you attribute the comparative immunity of the officers in comparison with the men?—To the different circumstances in which they were placed as regards the sledging work.

2973. In nearly all the journals we read that the officers joined the men at the drag-rope, and that in one case Lieutenant Parr, who of the extreme northern sledge party was the only man who was able to return to the ship and give information as to the position of his fellows, worked as hard and harder than most of them?—Of course, of my own knowledge I can only speak as regards the officers of the "Discovery," and I am not aware that all the officers dragged, but I am aware of the fact that Lieutenant Beaumont, who dragged during the entire time as much as the men did, suffered from scurvy. With regard to the last point, the nature of the physical work performed by the officers had some bearing upon the influence of the disease upon them. Lieutenant Beaumont suffered from scurvy, and I know of my own knowledge that he worked very hard. Lieutenant Rawson is a remarkable exception, he worked also very hard physically, and did not suffer.

2974. Have you any information which you can give the Committee upon the subject of the present inquiry which has not been elicited from you by the examination of the members?—I noticed certain peculiarities as to the effects of certain remedial agents. In the case of Chatell, to whom I gave a large allowance of lime juice from the time that he showed the very first sign of scurvy, no material improvement took place in his condition until after he came on a diet of fresh seal meat. Again, in the cases of Lieutenant Beaumont's crew, who suffered from scurvy, I was at first only able to administer to them lime juice in addition to such portions of the sledge fare as they could digest, and those men did not materially improve until after they got an allowance of fresh meat. Again, I might remark that two of the men of Lieutenant Beaumont's crew, who suffered from scurvy, exhibited fresh signs of the disease after they had been for five or six days taking a liberal supply of lime juice. In the case of Jones, the stoker, a fresh outbreak of petechiæ appeared on the legs after he had been, I think, seven days taking a large allowance of lime juice. In Lieutenant Beaumont's case, a fresh outbreak of large extravasation patches appeared on the legs after he had been for several days taking lime juice; and in Shepherd's case, his progress towards recovery seemed to date from the time when the weather in the spring became so mild that he was induced to take open air exercise. He seemed to get

rather worse and worse during the winter, although he was supplied with a large allowance of good lime juice, fresh meat, and medical comforts of various kinds. Among the remedial agents that I alluded to, I do not think that I pointed to the use of kidney-sorrel, which formed an essential element in the treatment of the men at Polaris Bay, inasmuch as I was able to administer a large quantity.

2975. It was gathered in the neighbourhood, was it not?—Yes.

2976. You had not scurvy-grass?—No, not scurvy-grass, only this kidney-sorrel.

2977. (*The Chairman.*) Assuming that a daily allowance of lime juice could have been administered to the sledge parties, are you of opinion that the outbreak of scurvy would have been delayed?—I believe it would.

2978. Are you further of opinion that it might or would have been averted?—I think that, taking into consideration the facts that if lime juice had been carried, the time occupied by the travelling hours of the day would have been shorter, and, consequently, that the fatigue to which the men were subjected, would have been much less, and, moreover, that the other articles of diet would be necessarily diminished in proportion to the weight of the lime juice and requisites, the distance travelled must have been shorter. Considering these facts, I think that if the lime juice had been carried, although the outbreak might have occurred, if it had occurred the type would have been modified. I mean to imply that, if lime juice had been carried, on account of these circumstances, it would have materially modified the conditions of the journey. Of course, I have taken other circumstances also into consideration.

2979. In such a case, what daily allowance would you recommend?—One ounce per day.

2980. Have you any ground for supposing that from a natural anxiety to get through as much travelling as possible, the days' sledge journeys at first made were longer than those which subsequent experience proved to have been expedient?—I am not aware that the working hours of the earlier days were longer than those of a later period. I think they were rather shorter; they certainly were so in the case of the sledge party which I accompanied. I found the men that I accompanied able to work much better after they had been a week away than at first. At first they were so unused to work of that nature, to using their legs so much in dragging, that they very soon got tired; but when they got used to that peculiar kind of work, and also got accustomed to the sledging ration, they worked very much better, and were capable of standing a longer working day.

2981. Are you entirely satisfied with the equipment of the "Discovery" for the special service in which she was engaged?—Yes, with the exception of what I have already suggested, and what I would recommend as improvements. I may also add that the salt beef was not so good as it might have been.

2982. In what respect was the salt beef not so good as it might have been?—It was very salt, and very hard and tough, exceptionally hard.

2983. Do you think it was superior to the ordinary salt beef used in the navy?—No, it seemed to be rather inferior.

2984. (*Dr. Fraser.*) Can you tell us, were you entirely satisfied with all the other articles supplied to the "Discovery" with the exception of the beef?—Yes.

2985. I should like to ask you if you have paid any special attention to the general principles of scales of dieting?—Yes, I have.

2986. In reference to the scale of diet, which represents the rations supplied on board the ship, have you made any calculation of the relative proportions of the essential food principles represented in it?—No.

2987. Have you done so in reference to the sledge dietary?—No.

2988. There is one matter that, perhaps, you could give me some further information about, and that is the dietary of the sledge parties. You are aware that

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in that dietary there is one pound of pemmican and four ounces of bacon, among many other articles, as part of the daily issue?—Yes.

2989. I find that in the case, at any rate of the "Alert," this four ounces of bacon was in some instances increased to six ounces, "at request, in lieu of pemmican." Now, are you able to tell us if, when this bacon was increased to six ounces, no pemmican was taken, or is it in addition to the one pound of pemmican?—It was in addition to the pemmican, it did not take the place of the pemmican. I believe there was an occasional reduction in the amount of pemmican carried by some of the "Alert" sledge parties, but bacon was not a substitute for pemmican.

2990. I quite understand that both were carried in perfectly sufficient quantity; what I wish to know is

this, when, at request, six ounces of bacon were substituted during an expedition for four ounces as a ration to any man, was at the same time, that is to say on the same day or on the same days, no pemmican consumed by that man?—Pemmican was taken in exactly the same way on all occasions, independent of the issue of bacon. Certainly as regards the "Discovery"; and my impression is, that it was quite the same as to the "Alert." Pemmican formed part of the daily ration independent of the extra allowance of bacon.

2991. At any rate, so far as your knowledge of what took place in the sledging parties with which you travelled goes, there was no such substitution of bacon for pemmican?—No.

2992. (*The Chairman.*) The only return that you have undertaken to furnish is a report on the provisions supplied to the "Discovery"?—Yes.

The witness withdrew.

CAPTAIN RICHARD VESEY HAMILTON, R.N., C.B., (Captain-Superintendent of Pembroke Dockyard), *examined.*

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2993. (*The Chairman.*) From the return which you have been good enough to furnish to the Committee, I observe that you have made four sledge journeys without dogs?—Yes.

2994. That on the first of these you left your ship, the "Assistance," on the 15th of April, 1851, in latitude 74°40', returning to her on the 13th of May, 1851, having travelled 232 statute miles in a temperature varying from + 31° to - 39°, accompanied generally by an amount of wind No. 4, having previously passed one winter in the arctic regions. That on the second of these occasions you left your ship, the "Resolute," on the 22nd of September, 1852, returning to her on the 7th of the following October, having travelled 156 statute miles in a temperature varying from + 31° to - 5°; wind as before. That on the third of these journeys you left your ship on the 4th of April, 1853, returning to her on the 17th of April, 1853, having travelled 117 statute miles in a temperature varying from + 3° to - 30°, wind considerably greater after having passed one winter in the arctic regions. That on the fourth of these occasions you left your ship on the 28th of April, 1853, returning to her on the 21st of June following, having travelled 627 statute miles in a temperature varying from + 30° to - 22°, accompanied by a good deal of head wind: making the entire distance travelled by you 1,132 miles?—Yes.

2995. In all these journeys, were any of your men affected by scurvy, or by symptoms which you would now be disposed to consider scorbutic?—No.

2996. To what do you attribute their immunity from scurvy?—The idea of scurvy never entered our heads, and, till this expedition returned, I had never thought on the subject of arctic scurvy. With reference to this subject, I should like to quote extracts from letters which I have received from George Murray, who was petty officer of my sledge in 1853. The first letter is dated December 21st, 1876: "Why did so many men get disabled by scurvy? is a question no one appears to be able to answer. A great deal has been said about the sledge parties not being supplied with lime juice. Neither were the travelling parties of the Austin and Belcher expeditions. The objection to carrying lime juice is its weight, a great object. Besides, it would have frozen in the earlier part of the season. . . . The sledge parties in our long journeys carried no lime juice. No man at our sledge complained of pains in the legs or had swelled ankles. . . . You are of opinion that the seeds of scurvy were sown and had germinated before travelling commenced. I suppose you think they had not sufficient out-door exercise; perhaps that is the case. Then you will remember we had no compulsory out-door work during the winter months under Austin or Kellett. Certainly no body of men in any climate for so long a period were more free from disease, and sledge parties on the long journeys carried no lime juice. I will now, sir, state to you my own opinion on the subject, which

will perhaps startle you. The crews were too young, unseasoned as to climate, and unaccustomed to hardships. It was the boast of those who commanded the expedition that there was not a man in it over 30 years of age; and from what I saw myself of the crews when in Portsmouth, the greater portion were not over 22 or 23; scarcely the men calculated to undergo the extreme privations and hardships attendant on a polar voyage. Depend upon it, had men been chosen whose ages varied from 30 to 40, the expedition would have been more successful. A man of 23 may have strength and agility, but he has not the endurance of the man of 35." The next letter is dated in the early part of January, 1877: "On the other hand, I may mention that with Ross, Port Leopold, the amount of compulsory exercise out-doors was eight hours a day. No matter what the weather, out you must go; no symptoms of scurvy among the crew. With Austin and Kellett we had none of this compulsory outside work until the early spring, when all hands were compelled to take a four or five hour's walk, travelling, say, out and in about 20 miles. We sailors used to call that 'walking drill,' and very good training it was. I need scarcely add there was no scurvy amongst us. . . . I still adhere to my old notion of the subject, that the crews were too young. Their constitutions were not sufficiently seasoned to stand the effect of an extreme change of climate on their systems, neither were they old enough to have experienced anything like the hardships attendant on a sailor's life. No doubt they were finely developed young fellows, and stripped well before the surgeons: but in such subjects often lurk the seeds of incipient disease, which the eye of the most observant doctor may fail to detect. It must be remembered there is a strength and endurance of mind as well as of body, and if the former becomes depressed disease will easily attack the latter. I therefore believe that scurvy was not the primary cause of the break-down of the sledge parties, only a consequence." On that point I may, perhaps, mention my own opinion, which was formerly that the men should be under twenty-five; but I think these letters have opened strong doubts in my mind on the subject. Then the next letter is: "Many thanks for your kind note. Tell the Committee that you know an old sailor who served during the whole of the Franklin search under Ross, Austin, and Belcher, and who during that time never drank a drop of lime juice, but always bartered it for grog, and whose system never betrayed the slightest symptoms of scurvy. As to men of twenty-one and twenty-two holding out longest, I can only say that it is contrary to my sea experiences, extending over a period of nearly forty years. I went to sea in 1817, and left off going at the end of the Russian War, June, 1856, seventeen years of which time was in the merchant service. I have no objection to be examined."

2997. (*Admiral Inglefield.*) Did you on any of your sledge journeys have any symptoms of scurvy;

did you experience any amongst your men?—None to my knowledge.

2998. Did you carry lime juice?—In 1851, on my sledge, we took a bottle, or perhaps two bottles of lime juice. About four days after leaving the ship the temperature rose to $+31^{\circ}$, a very unpleasant arctic temperature from its warmth. The bottles had previously burst in the cold weather. The men suffered much from thirst in this unusually warm weather, mixed the lime juice with snow, and ate it as water ice four days after leaving the ship.

2999. What sized bottles were these, and what were the probable contents of the two, and how much did they afford as a ration per man?—They were the usual lime juice bottles. I cannot trust my memory to the quantity.

3000. Gallon bottles or quart?—I suppose quart, the common glass bottles supplied to the ships; I should say about a quart, but I say that from memory entirely.

3001. How much was the amount that each man consumed *per diem* while it was in use?—It was all used in those few days, as, the bottles being broken, it would otherwise have been lost.

3002. Then there were two quarts distributed amongst how many men?—Amongst seven men. I suppose a great deal of it was wasted; I can only say that in four days after leaving the ship there was no more lime juice.

3003. Then it was given to them *ad libitum*?—It was never issued as a ration, and in four days it was all gone.

3004. Did you carry any other antiscorbutics with you?—The scale of sledge diet would give, I suppose, any, in the official records. I have no actual note of that, and I cannot remember what we actually carried, but my impression is, No.

3005. Was there any material difference in the rations which you carried on those journeys compared to what was supplied in the recent arctic sledging journeys?—I do not know what the last arctic expedition were supplied with.

3006. On the journeys in which you were engaged, did the officers work at the sledges with the men?—In my opinion on all sledges journeys I have been on, the officers worked as hard, if not harder, than their men.

3007. And doubtless you have experienced that the anxiety which attaches to the command of a sledge party must have some mental effect on the officer, while it probably has none on the minds of the men?—I think most of us were too young to be troubled in that way; our responsibilities sat lighter upon us than they would now, but still that had a certain effect.

3008. Can you inform the Committee as to the use of tea and rum on the sledge journeys in which you were engaged; how it was apportioned, and how issued?—We had a gill of rum a-day; half-a-gill was issued at lunch time in the middle of our march, the other half on going to bed at night. The tea was always issued the last thing at night. We had cocoa for breakfast.

3009. Can you inform the Committee what your opinion is as to the advantages of tea or rum, one over the other?—The advantage of the rum at midday was that the halt was only for half an hour instead of for an hour, which it would require to make tea; but even in those days of rum drinking, I have often heard the men remark they would rather have their tea at lunch time than they would the rum. With regard to the rum at night, I consider, that if not physically, it is morally a necessity. The moral effects of the rum at night are very great on the men. In the autumn of 1852 my sledge broke through the ice and nearly everything got wet through, and we were eight days travelling with wet things. I issued an extra half gill of rum which I made the men drink in their tea. Jack wanted to drink it raw, but as it was extra I said they must have it as I prescribed or not at all; about three

days after I heard one of the men remark (this man had no bag to sleep in), "I never feels warm till I gets my tea with the rum in, and then I feel it to the very tips of my toes." It gave them all three or four hours good sleep. The rest of the long autumn night was dozing and waking, and very trying.

3010. Did you find the use of tobacco beneficial or otherwise?—I never smoke myself, and seven men all smoking in a tent was decidedly disagreeable to me; but I believe its effects on the men were good.

3011. We have had evidence that a man who chewed tobacco, and yet went through as much sledge journeying as the rest of his shipmates, had no symptoms of survy, and it was attributed in some measure to this chewing of tobacco; have you any experience upon that head?—None.

3012. Was the lime juice that was served out during the winter on board ship always consumed by the men and in the presence of officers?—I cannot say, but my impression is that there was no difficulty in getting the men to drink it as a rule; that there were exceptions is evident, from Murray's letter.

3013. During the first winter in which you were engaged on arctic service, was there any scurvy or were there any scorbutic symptoms on board your ship the "Assistance"?—None to my knowledge.

3014. When did the first outbreak, if any, occur?—I am not aware of a case.

3015. Then you had no men who died of scurvy on your expedition?—None; but five died of other complaints in Kellett's expedition in the "Resolute" and "Intrepid."

3016. With your present information and the knowledge of the result of the late expedition, do you consider that acclimatisation has any effect, and is an advantage in selecting men for arctic service?—No. Some of the men who stood the cold best with us had recently returned from the coast of Africa.

3017. What was the average age of your men engaged in Sir Edward Belcher's expedition?—I can scarcely answer that question, but I should say about 30.

3018. Then, upon the whole, the men of that expedition were an older class of men than those engaged upon the recent one?—Yes, I think so.

3019. Did you obtain much fresh meat in the shape of musk ox, or reindeer, or game of any kind?—Very little with Austin, scarcely worth speaking about; a great deal with Kellett, 28,000 lbs. weight.

3020. Then was there any difference in the health of the crews under Austin and Kellett?—Austin's were a better set of men; more trouble was taken in entering them. To the best of my belief no man was entered without three medical men examining him; which was not the case with Kellett's crew. Kellett's crew can scarcely be called a picked crew.

3021. Do you happen to remember whether amongst the crew of Kellett's expedition there were many men who had served on previous arctic voyages?—Several; three of whom died. I think the death of those three men was rather against the idea of climate hardening. Two of the three men had been in Ross's expedition, and in Austin's expedition, and the other man had been in two expeditions. Two of the men were very hard livers; the third was a steady man.

3022. You have mentioned that you obtained an abundance of fresh meat while serving with Captain Kellett on board the "Resolute"; did you also obtain sorrel and scurvy-grass?—Very little.

3023. Were mustard and cress, or were other vegetables, raised on board the ship for the use of the crew?—I do not think so.

3024. You probably visited the ships which composed the recent arctic expedition before they sailed?—I saw them when they were in dock, but not after they were fitted out.

3025. Then you are not of your own knowledge able to say that the internal arrangements were of an improved description?—No.

3026. From what you have heard, would you con-

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sider them quite as well equipped as the ships in which you were employed?—I do not think so.

3027. State in what manner you consider they were different and not so well equipped?—I have had very little verbal information from those who were in the present expedition; but, judging from what little I have gleaned, their lower decks were much damper than ours, owing, in my opinion, to the want of a Sylvester stove.

3028. Were the provisions very similar?—Again, judging from what I have heard, their salt beef was much saltier than ours. Our beef, in 1852, was a little saltier than corned beef. I hear that the beef in the present expedition was very salt. In 1852, moreover, we were supplied with bacon, very good bacon indeed, instead of pork, which the present expedition were not. They had a considerable quantity of bacon, but not for daily use.

3029. Had you any difficulty in carrying this bacon in the ship?—No, none at all.

3030. How was it stowed?—In sides; some in tins, but the greater part in sides of bacon, just as we would take it into our houses from a large store.

3031. Where was this stowed?—I cannot say off-hand, but in the hold between the beams.

3032. Taking it for granted that lime juice is a useful antiscorbutic to carry on sledge journeys, and bearing in mind what you said just now with regard to the way in which the men mixed the frozen portions with snow, and made lemon ice-water with it, do you not think it possible that lime juice might be carried in capsules, so as to be distributed to the men daily, to be mixed either with their tea or grog?—They would not take it with either. If a capsule could be eaten, I have no doubt it would be useful, but I am quite sure no sailor would mix lime juice with either tea or grog; but, at the same time, I am quite sure that if lime juice could be carried in a condensed form, so as not to require fuel to melt it, it would be useful: the fuel could not be spared.

3033. When you were starting on your sledge journeys, did you receive instructions from the medical officers as regarded the treatment of scurvy, should it break out on the journey?—I happen to have my medical instructions given me in 1853 by Dr. William Domville and Dr. Toms (*producing them*), and the word "scurvy" is not mentioned in them.

3034. Was beer and wine served out upon the expeditions upon which you were engaged?—Beer to a considerable extent, both Allsopp's and beer brewed on board.

3035. Was spruce beer ever used?—No, we had no spruce beer; wine only for the sick.

3036. Can you remember what the condition of your men was when they were taken on board my ship at Beechey Island?—I believe in excellent health. I was myself.

3037. And do you remember the condition of the men of the "Investigator," that had spent four winters on the ice who came on board her at the same time?—The "Investigator's" were a splendid ship's company, and very soon after coming to us, where there was plenty of fresh meat supplied, they quite recovered from scurvy. When they left our ship they were in quite as good health as our own men.

3038. Had you many temperance men in your ship?—I only remember one.

3039. Have you formed any opinion as to the cause of the outbreak of scurvy in the recent arctic expedition?—The only official documents I know of are Captain Nares' general report and the chart of the travelling; and from that and my own previous experience, I have these observations to make: I do not consider that either the want of lime juice on the sledge journeys, or the severity of the travelling, can account for the scurvy. In my opinion, the seeds were sown and sprouting pretty freely before the parties left the ship; but the cause I cannot account for, unless it was the 45 days longer absence of the sun, and the want of Sylvester stoves; also the diet, those being the only points of difference between them and previous

expeditions that I am aware of; crews being also younger.

3040. (*Dr. Fraser.*) To which scale of dietary do you refer, to that on board ship or the sledge party dietary?—To that on board ship.

3041. And to what specially in the scale of dietary do you attribute the outbreak?—I have no statistics, and can only judge from what I hear; and it appears to me from what I hear that their salt meat was so salt that they ate very little, and preserved meats were used more freely than had been previously the case.

3042. I understand that you fortunately had very little scurvy in the expeditions you were connected with?—None that I am aware of.

3043. Your experience of scurvy, therefore, has been exceedingly limited?—I have no experience of scurvy.

3044. You have scarcely, fortunately for yourself, been in any position where you could have drawn inferences from direct observation of the causes producing any outbreak of scurvy?—No.

3045. Now, I should like to ask you, on what grounds you express the opinion that the seeds of scurvy were sown and had sprouted before the sledging parties left their ships?—In the first place, before travelling commenced, in Captain Nares's official account, an outbreak of scurvy is reported on board the "Discovery," although they had 3,000 lbs. of fresh musk-ox on board at the commencement of the winter. Captain Markham tells me that the first case of scurvy in his party was ten days after leaving the ship, and on the twelfth day two men were actually obliged to be carried on the sledge, from scurvy; and I have since heard that Dr. Moss, six days after leaving the ship, brought back two or three of Captain Markham's party with scorbutic symptoms. It is evident that twelve days of travelling did not give these men scurvy, if so, it is contrary to all previous experience; and also, I calculate that the "Alert" must have had 800 lbs. or 900 lbs. weight of fresh meat from musk oxen, shot before the winter commenced, so that both ships had more fresh meat than many previous expeditions had in their first winter. On the 35th day out Captain Markham has five men on his sledge, an unprecedented thing in other previous parties. Lieutenant Beaumont leaves the "Alert" about the 20th of April, the best season of the year for travelling; on the 18th day out he has a case of scurvy; and on the 31st day out all his party are more or less scorbutic. Judging from all previous experience, it appears to me ridiculous to say that these parties had not scurvy before they left the ship, or had contracted it during the journey. I see, again, with reference to Lieutenant Aldrich's party, which appeared to have had easier work than the others, that as their weights decrease their distances do not increase, and that he is the same number of days on the home journey that he was on the outward journey; the usual rule being three days out, two days home; evidently showing that his men were much enfeebled, and the work he went through was certainly not more severe than some have had. From what I have heard I consider the work that Captain Markham and Lieutenant Beaumont went through more severe than that of any previous sledge party of which I have any knowledge.

3046. You talk of an outbreak in the "Discovery." Are you aware that that so-called outbreak consisted of one case of scurvy in a crew of fifty-two?—I meant to say one case of scurvy. I did not mean to call it an outbreak.

3047. Are you quite satisfied that both of these ships had, during their first winter, an unprecedented quantity of fresh meat?—Not unprecedented, but more than the average. They had not as much as we had with Kellett, much more than with Austin.

3048. I think I heard you say that Kellett's ship had much more fresh meat than Austin's?—Yes.

3049. And which was the healthier crew?—Austin's; but they had only one winter, but even at the end of the first winter I think Austin's was

healthier than Kellett's; they certainly were as healthy.

3050. Are you acquainted with the dietaries of the sledge parties in the last arctic expedition?—No.

3051. Can you give us any information as to the dietary which you yourself used in sledge parties?—I suppose you have it before you, in statistics, and I would rather you should take it from that. According to my memory, it was a pound of pemmican, a pound of biscuit, six ounces of bacon, a quarter of an ounce of tea, half an ounce of chocolate, an ounce and a-half of sugar, a gill of rum, and condiments, such as preserved potatoes; two ounces I think we had of that, for mixing with pemmican; and curry powder and herbs of different sorts, to make things palatable.

3052. Did I understand you to say that you had two ounces of potato per diem?—I think we had two. We had biscuit dust in Austin's expedition to mix it with pemmican, but we changed it to potatoes in Kellett's. I speak from memory.

3053. In what form were the potatoes preserved, do you recollect?—Edward's preserved potatoes.

3054. Were any of the sledge parties to which you have referred connected with the voyage of the "Resolute," in 1852, 1853, and 1854?—I speak more of those sledge parties than the others, having been more away travelling then, and of course being older and having more arctic experience. Memory is, however, treacherous at the end of 25 years.

3055. You are not perfectly sure that there were no cases of scurvy, are you?—No; unless it were a very glaring case; as a young fellow, I should not trouble my head about it.

3056. I see in an account of your expedition by Lieutenant McDougall, that you are reported to have arrived with Mecham's crew and sledge?—Yes.

3057. And further, that most of you complained of sore ankles and feet?—Most of his men; but, they had marched 30 miles that day, and they had marched 21 miles a day on the average for 63 days. At the same time those men had not pemmican, they had preserved meat instead of pemmican, which was not near so good a diet for travelling on.

3058. In this expedition I think you came across men from the "Investigator," did you not?—Yes.

3059. Had they scurvy, any of them?—When they came to us all of them had scurvy.

3060. You cannot inform us as to their dietary, can you?—No.

3061. Had they any lime juice?—I feel sure they had, but I cannot inform you from personal knowledge; in fact I had that from Admiral Haswell; they had when they came to us.

3062. I think Sir George Nares was on the same expedition?—He was.

3063. I find, that at page 45, Mr. Nares (as he was then) was reported to have returned after an absence of 57 days, and that one of his crew is reported to be suffering from decided symptoms of scurvy. Did this case come under your attention at all?—No; I had nothing at all to do with it, and it was before I returned. I never heard of it prior to this, so it must have been a mild case.

3064. This sledging party, however, did use the same dietary as the sledging parties which you were connected with, I suppose?—Yes.

3065. And they did not use lime juice?—I think not. After we left the ships I believe lime juice was sent out to the dépôts from 8 to 12 or 14 days away from the ship. My only mention of lime juice in my rough travelling notes, which I have here, is leaving some for McClintock on the north shore of Melville Island, which was most probably sent there after we left the ship; at all events it is unlikely that I carried it for 50 days without using it.

3066. At any rate on the dietary which you yourself used without lime juice, and, I understand you to say without any scurvy, other sledging parties from the same ship did not so fortunately escape from that disease?—I am not aware of any of our sledge parties having scurvy, at all events no man broke down from

it; there might have been scorbutic symptoms and debility.

3067. Do you remember if there were many cases of so-called debility in the crews of these parties?—Nothing more than was to be expected from the severity of the work, and the length of time they were away from the ship. Sledge travelling in my experience, after some 33 years at sea, is the hardest work I have ever seen seamen put to.

3068. Scurvy having originated in the recent sledging parties, with the dietary to which we have referred, and with the absence of lime juice, to what would you attribute that scurvy?—I believe the scurvy originated in the winter, but the cause puzzles me completely. The work, sledging, hastened its development and probably aggravated the symptoms; even with lime juice, I do not think the disease would have been much, if in any degree, lessened, if, as I believe, the seeds were already sown.

3069. Were you well supplied with fresh vegetables on board the "Resolute"?—I believe very well supplied.

3070. I think you had an abundance of turnips, parsnips, preserved potatoes and carrots?—Yes.

3071. (*Dr. Donnet.*) Was the system of warming by the Sylvester stove adopted in all the expeditions to which you belonged?—It was in the two larger ships, but not in the steamers; their lower decks were much smaller, and were warmed by stoves.

3072. Had this system any superiority over the system of warming which was adopted in the late arctic ships, with which I believe you are acquainted?—Theoretically, I should say so; practically, I do not know; but judging from that great funnel in the middle of the "Discovery's" lower deck, she must have been a very difficult ship to warm with stoves.

3073. Can you describe the system of warming by the Sylvester stove?—It is a hot air stove in the hold of the ship, with pipes leading through the cabins and forward on the lower deck.

3074. I believe you have mentioned beer having been supplied to the men of your ship, was this brought from England or was it manufactured on board?—We had Allsopps' strong Burton ale, and a great deal was brewed on board the ship, and that was of an excellent quality.

3075. I believe you expressed a personal objection to preserved meats, was this due to the quality of the meat, or to its insipid taste?—This was only during the last winter I was out there, when Captain Kellett, anticipating our having to remain a third winter, kept us on rather short allowance, and, speaking from memory, I should say that preserved meat was only served out once a week, and the change of diet used to give me diarrhoea; it was more that, than actual dislike to the preserved meat; but with salt meat diet the greater part of the time, and lime juice and plenty of vegetables, I was perfectly fit for a third winter; in fact in the spring, of 1854, I travelled about 1000 miles with dogs. I ought to add that the quality of the preserved meat was very good.

3076. You had, as I understand, a greater quantity of fresh meat in Kellett's expedition than in Austin's, and yet I am under the impression, from your evidence, that the health of the former was not so good as that of the latter; to what was this difference due?—Much more care was taken in selecting the men for Austin's expedition than for Kellett's, the men for Austin's expedition, I believe, had to pass three medical officers; ours were taken in the ordinary way of the service.

3077. Was the quantity of fresh meat obtained small in Austin's expedition?—Very little was obtained till after the winter was over; in fact no fresh meat, only birds, had been obtained in the previous autumn. I should doubt if a fresh meal was ever served out that winter to the ship's company, speaking from recollection.

3078. You mention having taken lime juice with you in your sledge journey in 1851; do you remember whether it formed part of your sledge dietary, and whether it was supplied with a view of affording a

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certain daily ration to each man for the time?—I can give no information on that point. But for the fact of the bottles being broken, and the men using the lime juice, as I have already mentioned, I do not suppose I should have remembered our carrying it.

3079. In the ships in which you have served, was not lime juice issued as a daily ration to the men after they had been 14 days away from England, according to the instructions?—Yes.

3080. Did you form any opinion of the use and value of its issue?—Since 1856, on my way out to China, I had never been long enough at sea at one time without fresh meat to give an opinion on the point.

3081. Is it from want of experience that you do not form an opinion with regard to the use of this article?—Yes; I can only say for myself that, whenever lime juice has been served out on board, I have always taken my own allowance.

3082. From the information which the history of scurvy in our navy affords, and the very great decrease of that disease in the navy after the introduction of lime juice, would you not attach very great value to the issue of lime juice?—I certainly attach very great importance to the issue of lime juice; but the subject of scurvy is one which I have really never gone into. I have never seen any since I have been in the service, and, therefore, personally I have no opinion on it.

3083. From what has occurred in the late expedition, would you consider lime juice a necessary article for a sledge dietary?—No; it would take too much fuel to melt it, and the weights are so strictly limited, in order that you may be able to carry as much provisions as possible, that you would, by using lime juice, lose a certain amount of provisions; and not only that, but with a temperature of 30° or 40° below zero, which I have been travelling in, it is very unpleasant work standing while you are making the necessary quantity of water to mix with your rum or tea. Tied down as we were to weights in olden expeditions, we could not have spared the fuel. Theoretically, I do not doubt its value; but the difficulty would be carrying it into practical effect, I mean to say, where it is frozen, and has to be thawed; and considering, as I do, that the "Alert's" men were scurvy stricken before departure from the ship, I cannot believe lime juice alone would have produced the slightest effect while travelling.

3084. You mentioned that on your sledge journey your halt for half-an-hour prevented the making of tea, and that owing to the short delay rum was issued; did I rightly understand you that tea would have been preferred?—If we could have obtained it in the same time. The rum was a substitute for it. I believe tea would have been better.

3085. You mentioned that the men experienced much warmth after taking their evening tea and rum mixed; in your opinion was the warmth due to the spirit or to the tea?—To the spirits: the tea without the spirits had nothing like the amount of warmth in it. I always mixed my rum with the tea to get the extra warmth.

3086. Did you ever take tea alone without the spirits?—Yes, and its effects were not near so warming as with them. I very seldom drank my own rum except mixed in the tea. It was half-a-gill to a pint of tea, and therefore not very strong. But I have drunk proof rum at a temperature of 40 degrees below zero, and it had no more effect upon me than so much water as far as warmth was concerned. The same rum put in tea was much warmer.

3087. From this would you not infer that the warmth was due to the tea and not to the spirit?—It was due to the mixture; the tea without the rum was not so warming as with it. In saying that I speak from personal experience.

3088. (*The Chairman.*) You stated that you consider the officers worked harder than the men; explain how this happened?—Where the ground was bad, the officer, heavily laden, heavily clothed, with a heavy gun and ammunition, had to pick

the route, walking at a rate of from half a mile to a mile an hour, occasionally coming down with a jerk through an upper crust of snow; this, and the slowness and monotony were very wearying, and there was nothing more pleasant than to get a smooth bit of road, and instead of walking ahead doing nothing clap on the drag-belt and drag with the men. Then you appeared to be walking at the rate of about three miles an hour. Drop the drag-belt and you immediately found that you were reduced to about a mile. The officer, in addition, had his sights to take, which broke his rest, and the very anxiety not to lose them occasioned your waking up before your time very frequently. Then, while the sledge was travelling, or after the tent was pitched, you had to go and explore the land, and also in order to get the proper amount of work out of the men you had to show them that you could do as much as they could; also, when it was a case of "one, two, three, haul," or at any extra work. I have travelled with a satellite sledge and two men for a distance of about 180 or 200 miles, when I dragged the whole time with the men. The officer, however, has not to cook. The officer's place also in the tent was more exposed: he had no one to windward of him; he did not sleep between two people. That is not only my own experience, but it applies to every officer with whom I ever travelled, and especially of Sir G. Nares, who was my second in 1854.

3089. On your sledge journeys, what was the general character of the snow in point of depth?—It varied very much; but, of course, after a fall of snow it would be soft for three or four days, and a gale would harden it. Where the hummocks were broken up the snow between those would be soft for a long time.

3090. Had you much travelling where the ice was in hummocks?—About one quarter to a third of my whole travelling; but I do not think that our travelling was nearly so heavy as the late expedition had, from all I have heard.

3091. If you are furnished with the journals of the officers who commanded the Northern, the Western, and the Eastern sledge journeys, will you supply the Committee with your opinion on the difficulty of their sledge travelling compared with yours?—Having read Commander Markham's detailed journeys, and the reports of Lieutenants Beaumont and Aldrich, I have no hesitation in expressing my admiration for the zeal, energy, and brave determination of the two former officers and their crews to overcome the unprecedented obstacles they encountered; in my opinion, very far greater than any previous sledge parties have experienced. The journeys were extended to the utmost limits of safety; prudence would have dictated an earlier return; not doing so is the only fault (if a fault) committed. No officer could have pushed on so far, unless thoroughly supported by his crew; no crew would have so supported their officer had he not shown he exacted nothing from them he did not perform. From Lieutenant Beaumont's account the men appear to have started with the determination of equalling, if not surpassing, McClintock, Richards, and Mecham. They deserved the success they did not command, and showed that neither physically nor morally have British seamen deteriorated. Lieutenant Aldrich does not appear to have encountered, except from soft snow, greater obstacles than previous parties of "Assistance" and "Resolute." Had his men been in as good health as ours were, I believe his average distance would have been little less than my own in 1853, after a previous spring's experience of travelling. When the scurvy prostrated most of the crew, they displayed equal courage and patience under trial as the other parties. Till I read these reports, I had an impression on my mind we would have done better; but no unbiassed person can read these modest unassuming narratives and retain that impression. Of Commander Markham I had a previous slight acquaintance; the other officers I had never seen prior to their return.

The witness withdrew.

Adjourned to to-morrow at 11 o'clock.

SATURDAY, 20TH JANUARY, 1877.

PRESENT:

ADMIRAL SIR JAMES HOPE, G.C.B., in the Chair.

ADMIRAL SIR R. COLLINSON, K.C.B.

VICE-ADMIRAL E. A. INGLEFIELD, C.B., F.R.S.

JAMES J. L. DONNET, ESQ., M.D., Inspector-General of Hospitals and Fleets, R.N.

THOMAS R. FRASER, ESQ., M.D., F.R.S.E.

H. J. VANSITTART NEALE, ESQ., Secretary.

REAR-ADMIRAL GEORGE HENRY RICHARDS, C.B., F.R.S., *examined*.

3092. (*The Chairman*.) From the return which you have been good enough to furnish to the Committee, I observe that you made five sledge journeys from the "Assistance," in latitude about 76° north, but that of these the three first were of limited extent, the total distance travelled in them being only 218 miles, the two first being in the autumn of 1852, and the third in the spring of 1853. Further, I observe that you left your ship for the fourth journey, after one winter in the ice, on the 10th of April, 1853, returning to her on the 12th of July, after an absence of 93 days, having travelled about 960 statute miles, at an average daily rate of $10\frac{1}{3}$ miles, in a temperature varying from + 43° to - 8°, and that you left your ship for your fifth journey on the 22nd of February, 1854, after two winters in the ice; returning to her the 3rd of May, after an absence of 72 days, having travelled 529 miles, at an average daily rate of $11\frac{1}{2}$ miles, in a temperature varying from + 14° to - 42°, and that, therefore, the total of your arctic travelling amounts to about 1,707 miles?—That is correct.

3093. What was the general character of the ice over which your journeys were performed?—As a rule the ice was good, but of course there were exceptions. Occasionally it was hummocky, and piled up from pressure while the ice had been in motion, and, I might add, that during the months of June and July it was very bad, owing to the depth of the water on the floes.

3094. What was the character of the snow between those hummocks?—All the smooth ice was covered with snow some two or three feet in thickness, until late in the season, except the hummocks, which were sometimes nearly bare.

3095. Did your foot sink in this snow?—No; it was generally hard enough to bear the weight of the sledges on its surface.

3096. Have you read the reports of the sledge journeys performed by the late expedition, and how do they compare in point of difficulty with those performed by you, first as regards the land journeys, and secondly as to that over the ice to the north?—I have read the journals of the three extended parties of the "Alert" and the "Discovery," and, from their account, the ice was generally of a much heavier description, and much more difficult to travel on than I experienced.

3097. I want to draw a distinction between the journeys on the land and the journey over the ice to the north, which appears to have been much the most difficult of the three?—I understand that Commander Aldrich and Commander Beaumont's journeys were along the land, or at the edge of the land, but principally on the ice, and the other one was to the north, over the ice, and away from the land. I include all three in that answer.

3098. I observe that in your fourth journey the excess of distance travelled over that made good in the direction of your line of march, was 195 miles, whilst on the fifth it was only 20. Does that excess furnish a fair comparative estimate of the difficulty of the travelling?—No. I had better call my fourth and fifth journeys, my first and second extended journeys. The ice was more difficult to travel on during the first of these journeys than it was during the second; but on the first journey we were searching the coast, and went over more ground a great deal than we should

have done if we had been making a straight course, which I was trying to do during the second.

3099. Further, that on the first extended journey the average temperatures monthly were -5, +15, +30, +36, with generally not much wind; and on the fifth journey, -34, -28, -6, with wind of the same description?—Yes.

3100. Do these averages give a fair comparative estimate of the severity of the weather?—These averages are correct; but they do not give any idea of the severity of the weather during the early seasons. For instance, on my second extended journey, for eight days, we travelled at a temperature of about -40, which was very distressing; and I do not think the average temperature is any test of one's feelings during the whole of the journey; the men suffer very much in the low temperatures, while they do not so much in the higher temperatures.

3101. Will you state generally whether you consider that the severity of the weather on your first and second extended journeys was as great as that experienced during the sledge journeys, already adverted to, of the late expedition?—I have not their temperatures; but, evidently from their published journals, they seemed to have suffered more than we did.

3102. It has been stated to us that the work of the officers on these journeys is very much harder than that of the men; is that your opinion?—Certainly not. The officer leading the party or the single sledge, as the case may be, has to find the way for those who follow, and therefore he has more exercise and more labour than the other officers; but, as a rule, the officers do not drag.

3103. Would you consider that the officer leading the journey has heavier work than the men?—No, certainly not.

3104. In your sledge journeys were any of your men affected by scurvy, or by symptoms which you would now be disposed to consider scorbutic?—The men were frequently very much distressed and fatigued after their day's journey during the early and late season, especially during the late season, when, probably, for many days, they would be walking through water a foot or more deep; but I do not think any of my men were affected by scurvy, with the exception of one man in a party of fifty-seven, while they were with me; a second man was I believe attacked afterwards and recovered.

3105. Will you state, so far as you are able, the circumstances attending this one case?—The published travelling journal, in which the circumstances are stated, I have not with me; but this one man belonging to the "Pioneer," was not in a good state of health from the first, and he was sent back, I think, after about 16 days, with one of the returning sledges. I may add, that he died during the second winter of scurvy.

3106. To what do you attribute the general immunity of your people from scurvy?—I really cannot say. During the ninety-three days we had only four days' game, we never used lime juice, and the men worked constantly. I never had a man fall out from the sledge-ropes from illness, except on one or two occasions from snow-blindness, perhaps for a day or two.

3107. Could you state the reason why lime juice

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did not form part of your sledge rations?—I am not sure that we did not carry lime juice on the first extended journey but I am sure we never used it, I suppose, because it was frozen. We would frequently have been glad to have drunk water or lime juice if we could have got it, because everyone experienced great thirst during the early travelling, but there was no means of getting water except when we started in the morning and halted at night; we could not carry it, as of course it froze; even spirit did. I am under the impression that I left my lime juice in *dépôt* about twenty days after leaving the ship, when I wanted to get rid of all the weights I could.

3108. (*Admiral Sir R. Collinson.*) Can you give the Committee some information with respect to the comparative accommodation for the men on board the "Assistance" and the "Alert"?—Nothing could have been better than our accommodation on board the "Assistance." I visited the "Alert's" deck with the men on it more than once before she left, and it struck me as being very comfortable and spacious, but, I have no measurements. The ship was fitted out under Sir Leopold McClintock, and he would have all that information. I should like to add that our deck in the "Assistance" was a teak deck, which I think was a great advantage, as it was always dry.

3109. Did you suffer much in the "Assistance" from the drip overhead?—Yes; ice formed on the beams overhead during night, and melted and dropped all day, during the first winter; it was constantly necessary to sponge the beams.

3110. Was it better in the second winter, and why?—It was very much better the second winter in consequence of the hatchways being enclosed by building spacious wooden hoods over each of them. This plan was adopted by Sir Edward Belcher, and it almost entirely cured the wet. I have no reason, however, to think that the wet produced anything but discomfort.

3111. Have you reason to suppose that Captain Nares adopted the same precautions as you did on board the "Assistance" to cover the hatchways?—I do not know.

3112. He belonged to the "Resolute," did he not?—Yes, he belonged to the "Resolute" in our expedition.

3113. Was the "Resolute," when you got on board of her, fitted with coverings to the hatchways?—No; I think not, as our ship was.

3114. With respect to the journey which you made from the "Assistance" to the "Resolute," how many days did it take you to get to the "Resolute" on the first extended journey?—I think fifty-seven days, but that will be found in the published journal.

3115. How long did you remain on board the "Resolute"?—I think between two and three days, waiting for the return of Captain Kellett, who was absent, and it was necessary I should see him. I may say that my visit to the "Resolute" was not contemplated, we were entirely ignorant of her position when I left my ship.

3116. Then you relied entirely upon your own provisions, and were independent of the "Resolute"?—Entirely so. I took no provisions from the "Resolute."

3117. In performing that journey had you to unload the sledge and take several trips?—No; never, on that journey; except on crossing over the land on Melville Island. I have had to do so on short journeys when carrying a boat.

3118. With respect to the diet which you gave your men when you were away on the sledge parties, here is a list given by Captain Nares; would you glance your eye over it and see whether that is similar to what you carried when you were away (*handing a paper to the witness*)?—There is some slight difference. I think ours was something less than this.

3119. Not so liberal a diet?—Not quite, I think, but the difference is not worth remarking on. As regards spirits, our allowance was the regular service allow-

ance of that time, which was one gill of ordinary spirit: I see it is half-a-gill here.

3120. When was your ration of spirits issued to your sledge party?—One half at lunch time, and one half when we stopped at night.

3121. Was it acceptable to the men?—Very.

3122. Did you find that they were able to do their work as well after taking their spirits in the middle of the day as they were previously?—I think the men travelled better before than after; but men generally do travel better at the commencement of a journey. I would myself have given them tea if it could have been got in the middle of the day, but it was impossible to get it because we could not spare the time or the fuel. At night, however, I considered that the spirit was actually necessary.

3123. With respect now to the diet on board the "Assistance," was it similar to that which is here printed, and which is said to be "scale of diet arranged by Arctic Committee" (*handing the same to the witness*)?—Yes; this was as nearly as possible the same scale as ours. I may say as regards the "Assistance" and "Pioneer," that we never during our two winters got any game or fresh meat of any kind.

3124. (*Admiral Inglefield.*) Do you mean in Wellington Channel?—I find recorded in my journal that, on the Christmas of the second winter, we got served to our ship's crew 80 looms, which were brought from Melville Bay by Captain Inglefield in the "Phoenix," which was less than one bird a man.

3125. (*Admiral Sir R. Collinson.*) Do you consider that allowance of solid food to be ample for the men during an arctic winter?—Quite so; there were considerable savings in many things.

3126. Was your clothing in any way different from that of the recent arctic expedition?—No; it may be said to have been identical.

3127. Have you any account of the weights that were dragged by you during the sledging expedition at starting?—We considered that 216 lbs. a man was as much as could be dragged. I have had as much as 235 lbs., I think, on my sledge; but you cannot travel great distances with more than 220 lbs.

3128. (*Admiral Inglefield.*) Did the men on board your ship take their lime juice regularly during the summer and winter?—It was issued to them, but no compulsory measures were taken to make them drink it.

3129. Therefore, did they carry it to their messes?—I think it went to their messes in an unmixed state.

3130. Is it your belief that they drank it?—I really cannot say. It was very little drunk in the officers' mess. I never drank it myself, and our men were treated very much the same as the officers were in these respects; they were treated with perfect trust and confidence, and there were no compulsory measures necessary.

3131. Was there any difference in the qualities or quantities of the provisions issued in the late arctic expedition, in comparison with what was issued upon the expeditions in which you were engaged?—The quantities were intended to be the same. I think the qualities were in many cases superior in the late expedition, because all preserved vegetables are now produced in a higher degree of perfection than they were in our time; no expense or trouble was spared to procure everything of the best quality.

3132. Do you think that the lime juice deteriorates with the cold?—I really cannot say. I remember that we lost a considerable part of our lime juice through its being landed during the first winter, and the demijohns in which it was carried breaking through the cold; but I confess that I have very little recollection of the lime juice at all; it must have made no impression on my mind, for I have a perfect recollection of the most trifling events which did make any impression at the time.

3133. Did you carry medical instructions when you were travelling in sledges?—Yes; I think Dr. Lyall

wrote some few instructions for us as to what to do in case of frost-bites, &c.

3134. But scurvy was not thought of?—No, I do not think so; it never occurred to us that we should have scurvy in any serious form; of course we knew we were liable to it.

3135. I gather from your general evidence that there was very little sickness at all amongst your crews?—I find recorded in my journal, during the first winter, on the 2nd of February, 1853: "Medical surveys continue to be made twice a month, and though some few are not so free from tendency to scurvy as we could wish, on the whole we are in good health, and everything in the shape of antiscorbutics is being used; beer brewed on board three times a week, pickles and beetroot daily, also lime juice." That is the only time that I find lime juice ever mentioned in my journal. Then, as regards the health of the crew, I will read an extract from my second winter's journal, dated the 6th of January, 1854, where I say: "I find that I cannot muster so many travellers this year. I am only able to make up seven sledge crews from both ships instead of eight, and only three parties, exclusive of Sir Edward Belcher's, who are fit for very early and extended work, which is just half of what we could get together last year."

3136. When the sledges were engaged on long journeys, did not the officers occasionally fall into the sledge ropes and work with the men at dragging?—Occasionally, when the work was very severe, and I have known them to do so at other times.

3137. Was spruce beer made on board?—Beer was brewed on board, but not spruce.

3138. What were the regulations with regard to the use of tobacco, and did the men smoke or chew much?—I do not think they did very much. Certainly not chew; the rules as regards smoking on board were much the same as on general service, but it is very difficult to smoke during sledge journeys, and I rarely knew the men smoke, except at night in their bags.

3139. As a matter of fact, then, some lime juice was carried on the sledges?—I have an idea that some lime juice was carried on my travelling parties in my first extended journey, but I do not speak with certainty.

3140. It has been objected, or given as a reason for objecting to carry lime juice, the quantity of fuel that would be necessary to melt it, and the water to mix with it. Do you think that lime juice might be carried in small quantities, say, in capsules, and melted by placing it in a man's sleeping bag at night?—It is possible that it might, but such a thing never occurred to me.

3141. We have it in evidence that Captain Markham did so thaw in a quart bottle a sufficient quantity for the use of his party; if that could be the case with regard to one officer, and a quantity so large as that contained in a quart bottle, and supposing the quantity necessary for each man was not larger than the size of a bantam's egg, which has also been suggested, surely it would be possible, under those conditions, to thaw lime juice sufficiently to mix it with the tea?—I should think it would be possible; but the fact is that as we never had any sick people to speak of, no remedies occurred to us in consequence.

3142. This question I put to you rather as bearing upon our present experience than upon yours?—I have no doubt that a temperature could be got up on a man's person at night which would probably thaw lime juice, during some part of the time, but I do not think so in the early part. I know that spirit froze next my skin in a bottle covered with flannel.

3143. From your lengthened experience do you believe that there is any advantage in a man being acclimatised; that is to say, after having spent one winter, is he better able to withstand the fatigue and the vicissitudes of the climate, than he was the first winter?—My experience and observation are entirely opposed to such a view.

3144. That, in fact, he is literally more fit during his first winter, than he would be during his second?

—Certainly. Men lose strength after every winter, undoubtedly.

3145. We had a letter put before us yesterday from a seaman, the captain of a sledge, Quartermaster Murray, who was engaged upon the expedition in which you served in the "Resolute"; this man, in writing to Captain Vesey Hamilton, said that he had considered the question of the outbreak of scurvy in the present expedition, and that he imputed it more to the unmatured condition of the men, as regarded their age, than to the absence of the exhibition of lime juice, and he gave as his reason, that on board the recent expedition it was the boast amongst the officers that they had no men over 30 years of age, while the men composing the expedition in which you were commander of one of the ships were all more or less nearer to 40, or between 30 and 40; and he argued that, although the men of the late expedition were fine, healthy, strong looking young men, their constitutions were hardly formed, and therefore they were more susceptible to the influence of climate; do you at all agree in that opinion?—It has occurred to me before that the men in this expedition were rather young, but the generality of our men were not over 30; of course, in exceptional cases of the petty officers, they might have been more, but, speaking from memory our seamen were not over 30 as a rule.

3146. If you were required now to select a crew for arctic service, with all the experience which you have have acquired and with the knowledge you have of what took place in the recent expedition, what age would you consider the best average age for the selection of the seamen of the expedition?—I should say 30.

3147. Not under?—Not under. I may say that, while the Arctic Committee were sitting, I had my own misgivings as to the proposed ages of the men. I think that the limit of age from 20 to 30 was rather low.

3148. May I ask if you can inform the Committee who fixed that average age?—It was contained in a report which the Medical Director-General made, and which was sent to the Committee for their information and guidance.

3149. Those, I presume, were the instructions, or rather the suggestions, which were made to the Arctic Committee?—The Admiralty informed us that the principal officers would give us any assistance we desired, and the first day that the Arctic Committee sat they wrote to the Medical Director-General, and asked for any suggestions that he might desire to make on the sanitary questions connected with the expedition, and in his report, which we received through the Board of Admiralty, I think these ages were mentioned. He recommended men varying in age from 20 to 30 or 32, and then he went on to describe the stature, &c., that he would recommend.

3150. Does he allude to the question whether they have been employed on previous arctic service, or in tropical climates?—I will read the extract, if the Committee wish it, it is as follows: "Men for arctic service should be of a cheerful disposition, free from disease, without blemish and without spot, inured to the life of a sailor, in other words, a regular man-of-war's man; in age varying from 20 to 30 or 32, of middle stature, well-proportioned bodies, strong and active, with a well-developed capacious chest, sound heart and lungs, organs which, under any circumstances, are the most severely taxed; of stout muscle and limb, with a light, active gait; and free from any constitutional or hereditary predisposition to disease. I would further add to this, that men of middle height and weight are more desirable for every reason than large heavy men." Then the Medical Director-General says: "The duty of examining the men previous to entry becomes one of the first importance, and too much care cannot be shown on the part of the medical officers in the discharge of this duty, on which so much of the success of an expedition depends. Officers should undergo quite as rigid an examination as the men."

Rear-Adm. G.
H. Richards,
C.B., F.R.S.

19 Jan., 1877.

Rear-Adm. G.
H. Richards,
C.B., F.R.S.
20 Jan., 1877.

Then follows: "I have in the above extract given a larger limit of age than I think desirable, and I would prefer fixing the age of the men at thirty instead of thirty-two," meaning, as I understand, the maximum. "Of course, a hard and fast limit cannot be always adhered to, but I would prefer having men under thirty than above it, provided they were in all respects thoroughly sound and well developed."

3151. In your selection of men for arctic service, would you give a preference to marines or to seamen?—I think some of our best men were marines. I should say that our marines always dragged as well as the seamen. Marines who had been at sea I should consider quite equal to seamen for sledge journeys, but not to be employed exclusively.

3152. Did you obtain in any of your journeys sorrel or scurvy-grass?—No, none.

3153. You have already told us, I think, that game was very scarce?—I never got any game except on the first extended journey, and then we did get some game; but we could only make use of it for four days, because we had not fuel to cook the rest, and therefore we left it.

3154. Did you grow mustard and cress during the spring?—We did during both winters, but we had it only three times each winter.

3155. Was it serviceable?—Each man got one ounce on each occasion; that is to say, every man in the two ships got three ounces during the winter, and the sick got a little more.

3156. Why should it not be grown in larger quantities?—It takes sixteen or eighteen days to grow, and you can only grow it alongside the stove, and there was no room for any more, in a sufficient temperature for it to grow.

3157. What was the condition of the men of your ship after having spent two winters in Wellington Channel, when they came on board the "Phoenix" at Beechey Island?—A great many of them were in very feeble health; generally, I should say, they were in a debilitated condition.

3158. With scorbutic symptoms?—With general debility. I cannot say for certain that they were scorbutic symptoms, but the men were weak.

3159. And quite unfit to pass another winter there?—Yes; in my opinion quite unfit.

3160. Or to have made an extended sledge journey?—Certainly. I could only get four sledges after the second winter, I believe that after a third, the men could not have travelled unless in an effort to save themselves.

3161. Do you think that excessive cold, lengthened darkness, and fatigue, which the sledging parties in the late expedition underwent, was the cause of the extraordinary outbreak of scurvy amongst the men?—I cannot say whether the lengthened darkness predisposed the men to scurvy. The men were said to be in excellent health when they left; but I have no doubt in my own mind that the breakdown was due to the other causes named, or mainly so.

3162. Have you had any experience of the use of compressed tea; and, if so, do you consider it as good as the ordinary tea?—I have had no experience of it, beyond tasting it at the Arctic Committee.

3163. Comparing the Esquimaux and Europeans, do you think that Europeans are more susceptible to scurvy than the Esquimaux?—Under the same conditions, probably they might not be, but I do not think that any parallel can be drawn; they do not engage in labour, unless in pursuit of food. We never saw an Esquimaux in our expedition after leaving the Danish settlements of Greenland.

3164. Have you heard that the Esquimaux have scurvy amongst them?—I have not heard it from any source that I should consider authentic, although I have heard it mentioned.

3165. A suggestion was made by one of the officers who gave evidence before the Committee, that if, instead of covering the deck with snow, as is the custom in arctic ships, snow walls had been built on either side of the living deck, and if it had then

been housed in, there would probably have been a less amount of condensation on the deck below, and it would have increased the area of space covered in from the severity of the weather; is it your opinion that that would be as beneficial, or more so, than covering the deck with snow?—I think building a wall of snow on each side of the ship would have considerably decreased the area of the ship; it would have decreased the area of the deck.

3166. But the object of it was to keep the hatches open instead of battening them down, and so prevent condensation?—Snow walls could not have been substituted for the canvas housing. Our temperature on deck was pretty much the same as the temperature on the floe outside, although we were housed in snugly; there was never more than two or three degrees of difference inside the ship and outside on the upper deck, during the first winter; during the second, there was a greater difference, as we had a second housing of sails.

3167. But you told us that Sir Edward Belcher in his second winter had something similar to what I described?—He built houses of wood over the two principal hatchways, and those houses acted as condensers.

3168. It was with the same view that this snow-house on deck was suggested, only that it should cover instead of each hatchway a large space of the deck?—I do not think that such a suggestion is anything like a practical one.

3169. Do you consider, that if lime juice had been issued on the sledge journey on which the scurvy broke out, it would have been the means of abating its virulence?—The travelling parties from these ships left under very unfavourable conditions. Instead of having to go in one or even two directions, they had to go in three, and so the parties were all numerically weak. Then they started over the worst possible ice, and they had the greatest difficulties to encounter when they were least able to bear them, that is, in the early season; moreover, they had heavy loads. In fact, the Northern party, before ten days were over, were attacked by scurvy, and the Northern party must have known that there was no hope of success before they had been out a week; the Eastern party was attacked very shortly afterwards, I think after 17 days. The Western party, which was under more favourable circumstances, as regards both travelling and weights, was attacked still later, I think after 27 days; but they all collapsed before they turned round to come back. I cannot conceive myself that lime juice would have prevented this; I believe that the breakdown was the result of utter prostration, owing to the extraordinary exertions that were demanded of the men.

3170. When you say that they started under adverse circumstances, do you mean that you believe that the men, owing to the lengthened winter, had their constitutions in some measure broken down, because they were reported, and we have had it in evidence that they were all in good health when they left the ship?—No; I do not mean that. The adverse circumstances were the fact of their having to undertake three journeys with not sufficient force, and that they met with very unfavourable conditions of ice, and that they had heavy weights to drag. These are the unfavourable conditions that I allude to.

3171. Taking that view of the case, if the three expeditions had all been directed to the one object of reaching the Pole, do you think that they would have been more successful?—I do not think there was the slightest hope of reaching the Pole, when it became known that no land existed in that direction.

3172. Do you think that if the three parties had been directed to the one object, they would have attained a higher northern latitude?—Yes, they would doubtless have got further than they did.

3173. Do you mean because they would have supported each other?—They would have had more men to carry the same weights; but parties cannot travel very far, unless it is along the land, because, in leav-

ing the land you are obliged to carry boats, and that increases the weights to an extent which they cannot carry. It was laid down before the expedition left, that no extended journeys could be made over ice where there was no continuous or nearly continuous land.

3174. Not even if they had found such ice as you found in the middle ice in Baffin's Bay, which is comparatively smooth, so that often a man may walk for miles as an afternoon's amusement?—Upon such ice as that, you would be certain shortly to come to water or ice not fit to travel upon.

3175. If you were only allowed to take one of the two things, do you consider it best that the men should have abundance of tea, or abundance of rum; to which do you give the preference?—I would take certainly an allowance of rum, and I certainly would take tea also: we always carried both. We had plenty of tea, but the difficulty which cannot be got over, is want of fire; even if you had the fuel you cannot afford the time to stop.

3176. To which do you attribute the greatest beneficial effects?—Tea was very much prized by the men, but it was impossible to have it except once a day. The rum, in my opinion, was of most value when we came to halt at night, to enable the people to change their foot gear, &c. The men could not take their hands out of their mits to do anything until they had got a little circulation, and we could not get tea probably for an hour and a half after we stopped at night. My experience, was that we pitched the tent, then the men had their half allowance of rum served out, and got into their blanket-bags, and then, when the cook had cooked the pemmican and the tea they had that, and went to sleep if they could; but I believe the rum materially assisted in getting them to sleep.

3177. With your long experience of sledging, and your knowledge of what took place in the recent expedition, supposing another attempt were to be made to reach the Pole, in the manner which has been attempted by the last expedition, can you suggest any way in which it would be more likely to succeed?—I hope that an attempt will never be made to reach the Pole again by sledges. Smith Sound was the only route which seemed to offer a chance of success with sledges, and it proved a failure; but if it were to be made again, I should certainly recommend the two ships to winter within 100 yards of each other.

3178. On what ground?—First on the ground that they would have the whole force available, and next on the ground that I think that two ships wintering together are much better in every way than one.

3179. You found that to be the case when the "Assistance" and the "Pioneer" were wintering in Wellington Channel?—Yes, I have always held the same opinion.

3180. Have you any suggestions, with reference to the subject of the present inquiry, which you can make to the Committee, and which have not been elicited in the evidence which you have already given?—I think the Committee have my views as to what produced the outbreak of scurvy. I do not think that I have anything more to suggest, except that when I say that I hope no attempt will ever be made to reach the Pole by sledges, I should like to add, that I think the fact has been greatly lost sight of, that sledge travelling was, if I may say so, invented for the purpose of seeking for missing ships. I do not think that sledge travelling would ever have been resorted to as a means of exploring the arctic regions. I think this has been greatly lost sight of by ourselves, and followed by other nations.

3181. That, in fact, where a ship cannot penetrate in the way of discovery, a sledge will fail to do so?—No, I do not mean that. Ship exploration and sledge exploration are entirely different. A ship can go where there is water; a sledge can only travel for a distance on the ice, along a coast; but it is not worth the cost of exploring such coasts as those of the arctic regions, at the rate of a few miles a day, at the expense of the men's health certainly, if not their lives.

I hope, if further explorations are made, and I hope they will be made, that it will be where ships can steam.

3182. (*Dr. Fraser.*) I gather from what you have said, that you impute the cause of the scurvy to the specially unfavourable conditions attending these sledging parties?—I impute it mainly to the heavy labour that they encountered.

3183. You do not think that it could be the result of any fault in the dietary, do you?—Judging from my own experience, I should say certainly not. Exercise was a most important thing for the crews in winter, and I do not know what was done in that way in the late expedition.

3184. Your experience was a very fortunate one, was it not? You had almost no scurvy?—I think in our whole expedition, that is to say, the expedition under Sir Edward Belcher, which consisted of five ships, we were very fortunate in our comparative freedom from illness, considering that one division of it, at all events, had no fresh meat at all.

3185. Do you think that the amount of work done in the conditions which we know existed, would always necessarily produce scurvy, whatever the dietary was?—Something may have been due to the ages of the men, but I think that the exertions which these sledge crews went through, so far as I can judge from the journals, were sufficient to break down any men.

3186. I need scarcely ask you, but you know, I dare say, that scurvy has very frequently occurred where there has been no exertion of a special kind?—I have frequently heard of such cases.

3187. Therefore, the mere fact of the great exertion need not have been, the cause of the scurvy?—I suppose, although I speak under correction, that great debility or great prostration in an arctic climate would produce scurvy. The sledge crews were evidently suffering from great prostration, I think due, in a great measure, as I have said, to the unfavourable conditions that they met with immediately on starting; that is to say, before they had got seasoned in any way to the work. It is noteworthy, also, that the officers were not attacked. Always in early sledge travelling some days elapse before the men can eat their pemmican or can sleep at night.

3188. The utter prostration to which you refer did not show itself immediately on starting, did it?—No; it occurred at shorter or longer periods, according to the weights the men had to drag, and the unfavourable conditions that they had to travel under, as it appears to me; that is to say, the Northern expedition were attacked first, then the Eastern one, and later on still the Western one.

3189. Utter prostration is itself one of the very earliest symptoms of scurvy, as I dare say you know?—That is my impression; but the men do not appear to have been attacked who did not undergo the extreme labour.

3190. You are quite familiar, I dare say, with the diet used by these sledging parties?—Yes.

3191. It differs in some important respects from the dietary used on board ship, does it not?—Yes; inasmuch as you do not use pemmican on board ship.

3192. By whom was this dietary prepared for the sledges?—I assume that Captain Nares was guided by the printed journals of former expeditions, in which our sledge dietary was given; in fact, I know he was; moreover he had his own previous experience.

3193. It was not as the board ship dietary, prepared by the Arctic Committee, or specially recommended by the Arctic Committee, was it?—The Arctic Committee only prepared the ship dietary for this simple reason: that they wanted to complete three years' provisions for the two ships, and they took the scale of diet which they had themselves used, and prepared the quantities for the period, on that scale; otherwise, I think, we would not have proposed the diet for ship board; it was equally on record as the travelling diet, and they thought it quite sufficient. (Appendix No. 31).

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3194. And they did not propose this sledge dietary?—No; it was essentially the same as our own in former expeditions.

3195. You had some scurvy with your own sledge dietary?—I had one man in a party of fifty-seven, and the late Admiral Osborn had also one man in his sledge party after he left me, his crew were included in my fifty-seven men, and he told me that he suffered himself from it. That was on the same journey as my first extended journey.

3196. Was there much debility shown by your crews?—My crews were very much distressed during the months of June and July, in returning when the water was very deep on the floe; but no man was ever so bad as to be unable to drag.

3197. What dietary had the men who joined Admiral Inglefield subsisted on?—Our ships were abandoned after the second winter, and Admiral Inglefield brought them to England, or part of them; other ships brought the remainder.

3198. Then, before the ship was abandoned the dietary was the ordinary ship dietary?—The same as is shown in our scheme of victualling; it varied slightly from time to time. Our rations were never reduced during our sojourn in the arctic regions.

3199. During the time that you occupied in travelling from your ship to Admiral Inglefield's, did you carry lime juice?—No; we carried nothing but what we stood up in, and sufficient provisions; we dragged our boats with us, and lime juice was not thought of during that three days. It was merely an ordinary march over the ice for a distance of 50 miles, partly ice and partly water.

3200. Then before leaving your ship, had the men been using lime juice up to the time of departure?—I have no doubt that it was served out as a part of the regular ration, but, as I said before, I have no recollection of any compulsion being used to make men drink it. I am sure it was not so used.

3201. The men did suffer from scurvy at that time, or at least from scorbutic symptoms?—They were not free from it, that is to say, many of the men had sore gums and discoloured limbs. They were not in a state to have undergone any great fatigue, and I suspect many were suffering from incipient scurvy.

3202. Now, in the means you adopted during winter for ventilating your ship, was the covering of the hatchways one of the steps taken?—Yes; to promote ventilation, and to get rid of the moisture; it was for this that the principal hatchways were housed over.

3203. Was that rather to maintain an elevated temperature than to facilitate either the ingress or the egress of the air?—It did not alter the temperature, but the moisture, instead of resting upon the beams, ascended up these two hatchways and congealed there. The inside of these houses was covered with ice, instead of the beams of the sleeping deck.

3204. You derived, therefore, great benefit from having adopted this method?—We derived great comfort. I cannot say that we derived great benefit, as regards health, but it was a comfort not to be constantly drying beams, and of course it was a great comfort to the men that the wet did not drop into their hammocks.

3205. What then, in your opinion, are the special difficulties in ventilating a ship in the conditions in which it is necessarily placed during an arctic winter?—The conditions against it are, that you admit so much cold air that the men could not live on the deck. If you had an unlimited supply of fuel there would have been much less difficulty. I find frequently recorded in my journal that we had not enough fuel for a sufficient allowance each day to keep up the temperature on the lower deck. If we could have done that we could have improved our ventilation, no doubt; our decks were always clear in winter for about five hours a day, everyone was off them during this period.

3206. The great coldness, I understand, is the chief obstacle to the renewal of the air?—Yes.

3207. Do you think it would be advisable, in order that that may be more frequently done, to economise

fuel by always heating the air entering from the outside?—If it could be done. I do not see quite how it could be done; our ships, I may remark, were fitted with warm air pipes, which the present expedition were not.

3208. If the cold air admitted into the main deck were heated by the stove or other heating appliances previously to its distribution on the deck, would not some advantage be gained?—If the heated air could be introduced on to the lower deck from outside, it would doubtless be of great advantage, as it would promote ventilation.

3209. Do you think it would have any effect on the dryness of the atmosphere also; of course heated air having the power of holding in suspension a much larger quantity of vapour than cold air, taking into account also that by the increased temperature of the air admitted, the renewal of the air could be more frequently effected?—I think there can be no doubt about that; if heated air could be introduced it would promote ventilation between decks.

3210. And the amount of vapour between decks given off by the men, and originating from other sources, is one of the great obstacles to proper ventilation between decks, is it not?—Yes. Our great object was to get rid of that vapour, which we did to a great extent in the second winter, by the means I have already described.

3211. (*Dr. Donnet.*) Am I right in believing that the system of ventilation adopted on board the "Assistance" was that which is caused by a stove in the bottom of the ship, commonly called the Sylvester stove?—The warmth of our lower deck depended principally on the Sylvester stove. It was always lit from the 1st of September until the travelling parties left.

3212. What consumption of coal was required per day for the purpose of keeping up the heat of the stove?—We commenced with 65lbs., but before the first winter was over it was increased permanently to 85, and it would have been much better if we would have afforded 100, but we could not.

3213. Did you find the ventilation of the lower deck improved by this system; did you think the ventilation of the ship was in any way affected by this stove?—No; I think not. We tried a great many things to promote ventilation. For instance, we worked the fire-engine and the pumps; that was one of Sir Edward Belcher's specialities, the promotion of ventilation, and he left nothing untried.

3214. Did not the open pipes, of which you make mention, conveying hot and fresh air to the different parts of the ship, communicate with the Sylvester stove?—The pipes from either side of the ship were in direct communication with the Sylvester stove, by cross pipes, but there was very little current of warm air kept up by these pipes, in consequence of our not having enough coal. I am certain the pipes warmed the ship, but I think they had very little to do with ventilating it.

3215. What was the temperature of your living deck during the winter months?—At night the temperature went down to 30°, because the stove was always allowed to burn very low then; but generally our temperature in the day time was from 35° to 48° on the lower deck.

3216. Was the moisture, which generally proves distressing on board a ship, frozen by this low temperature?—It was frozen during the night, and when the temperature rose in the day time there was a continual dropping in every part of the ship, except the Captain's cabin; probably because only one man lived in it.

3217. Had the pipes connected with the Sylvester stove any communication with the outer air?—No, none; they were open at the after end, and, I think, at both ends in the ship, but no heat came from the Sylvester stove into the Captain's cabin, though they opened into it.

3218. The only fresh air, then, could have come down the hatchways, or had you other means?—We had

ventilators open; some of the smaller hatchways were fitted with ventilators, and of course a certain amount of air came down the larger hatchways whenever the doors were opened for the people to go up and down.

3219. Had you reason for believing that the cold, which in one of your sledge expeditions registered -40° , had any influence upon the general health of the men of your sledge party?—Yes; I find recorded in my journal, that I do not believe the men could have stood out for another day. They were unable either to sleep or eat for that eight days to any extent.

3220. This very low temperature, fortunately, was not continuous?—I only set out on that occasion to go from the "Assistance" to the "North Star" at Beechey Island, therefore I knew how long it would take me.

3221. Is it advisable to travel when the temperature is as low as the above?—Not unless for some very short period, or when some great object is to be gained; but in an arctic travelling season there is not a day to be lost, you are obliged to travel as early as possible, and to remain out as late as possible.

3222. You say that the men suffered from thirst, did any of them attempt to eat snow to quench it?—In the early journeys we all suffered from great thirst, and there was a disposition on the part of the men to eat snow, but it was always discouraged.

3223. The appetite of the men was less, you say, on commencing their travels when they did not care to eat the pemmican. Did this assist in reducing the strength of your men?—During the first week the men always fell off from want of appetite and want of sleep, but they quickly recovered.

3224. Was their sleep afterwards good?—Fairly good.

3225. I believe I understood you to say, that in none of your sledge expeditions was lime juice taken, excepting in the one you took in the first spring after the first winter; was that so?—I am sure we took it in no other journey, and I am doubtful whether we took it then; but I have some recollection of a small tin can, during that first extended sledge expedition, which would contain about five or six pints, being on my sledge.

3226. I am under the impression that you carried lime juice with you, and left it in casks in dépôt twenty days after leaving the ship?—Not in casks, in *câche* or *dépôt*. I have a kind of recollection that I did. I find, on referring to my journal, that I left several things in a dépôt about twenty days after leaving the ship, and I quite remember that there were tin cans among them, and I think one of them was a lime juice can.

3227. Can you call to your recollection whether you gave any lime juice to your sledge party previous to your visit to the dépôt?—I am sure I did not, because such a circumstance as thawing lime juice must have occurred to my memory.

3228. I gather from your evidence that you attached little value to the use of lime juice in the arctic expedition to which you belonged: Have you changed that opinion from the experience which the late arctic expedition has afforded, and will you give the benefit of your present opinion to the Committee?—No, I have not changed that opinion. I do not deny at all that lime juice may be very useful, but nothing ever occurred in our expedition to call it into special use, nor can I persuade myself that the absence of it in the sledge parties of the late expedition was the cause of the breakdown. Probably if my crews had been struck down, and I had had lime juice, I should have tried it as a man would try everything in such a case.

3229. Not with any faith in its virtues?—No, I do not say that; simply that lime juice never appeared to be called for in our expedition; we never found the want of it.

3230. Had you the responsibility of fitting out a future expedition, and with the light of your present knowledge, would you add lime juice as a ration to the sledge diet?—If lime juice could be produced in such a form that it could be used in sledge travelling,

it would be my duty to carry it or anything else which, on competent authority, was considered likely to reduce the probabilities of illness, whatever my own opinion of its efficacy might be, and in the case of lime juice, weight would be no deterrent.

3231. Do you think that the long absence of light had any appreciable effect upon the state of the men's health in the late arctic expedition?—After all, they were not very many more days than we were without light. The absence of light, of course, turned men very pallid, and it had the same effect on the mustard and cress, which was yellow instead of green; and all our people looked yellow and discoloured after a winter on the return of light. It certainly had an effect upon the spirits of some very few of our people.

3232. I believe you mentioned in your evidence to the Chairman, that you had no doubt in your own mind of the cause of the breakdown; what then do you think was the cause of scurvy in the late expedition?—The cause of the breakdown among the sledge crews, in my opinion, is attributable to their dragging heavy weights over very unfavourable ice in a very early part of the season; in fact, to their strength being over-taxed. I can suggest no other reason.

3233. In the sledge expeditions in which you were engaged, you say that you met with little fresh meat, no scurvy-grass, and no lime juice?—Only four days of fresh meat, no scurvy-grass and no lime juice, certainly.

3234. And used no lime juice, and yet you were comparatively free from scurvy, for in the 57 of your party you believe you had only one attacked with it; do you think that the immunity which your party enjoyed over the parties of other sledge expeditions was due to any causes which may operate with greater force in the arctic regions during one year than another?—I do not think my parties enjoyed any immunity over other parties of our expedition, but I believe a great deal was due in our case to a favourable start for the sledges over fair ice, and that the men had time to get seasoned before they were called upon to undergo very severe labour. We may have been, for all I know, on the verge of scurvy; the last straw breaks the camel's back.

3235. I believe you expressed an opinion that no extended journeys could be made where there was no land, and that an attempt made over a floe with no land to travel along would be attended with failure; is that your belief?—That is my firm belief, I except, of course, crossing an enclosed strait from one side to the other, which has been done to the extent of 40 miles. There is one thing that may have operated with these sledge crews in the last expedition, and it is this, that in most of our parties there were some men who had been sledge travelling in former expeditions. Now, in this last expedition there were none; and I think it was, indeed I know it was, a great encouragement to our people to feel that there were men among them who had gone through the same hardships before. I think that kind of thing would tend to keep men's spirits up, and I believe it did.

3236. You mentioned having served out beer during your expedition; was this beer manufactured on board?—We carried a large quantity of first-rate Allsopp's ale in casks from England, which lasted, off and on, during the first winter, and we made beer on board as well. It was, of course, of a very inferior kind, but it was very eagerly sought after. This expedition did the same, as far as carrying the same kind of ale in casks went.

3237. Did it require any degree of extra warmth in making the beer, and how was this warmth procured?—Yes, it was made alongside the Sylvester stove, and allowed to ferment there.

3238. (*The Chairman.*) What size of vessel and number of crew do you consider best adapted for arctic expeditions?—I would have preferred something smaller than the "Alert," but it was impossible to carry the three years' provisions in anything smaller than she was, considering the space that was taken up by her engines, &c.; but, on the whole, I

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think that the two ships were extremely appropriate ships for the work. The only reason why I say I would have preferred a smaller ship is, that she would be more economically and more easily kept warm, and there would not be the same danger of being nipped by ice with a small ship that there would be with a larger and longer one.

3239. Supposing that two ships were sent on an arctic expedition, with orders to remain together, would you in that case recommend a third supporting ship?—It would of course be better, but I should have no hesitation myself in going with two ships, and wintering with them together. My belief is, that where a ship can go one year, she will almost always be sure to come away again the next, except in very special cases, such as Franklin's ships, where they turned a number of corners and got into a cul de sac. In the position the ships of the last expedition were placed, there was no danger of their not breaking out.

3240. Referring to Franklin's last expedition, would

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3242. (*The Chairman*.) From the return which you have been good enough to furnish to the Committee, I observe that you made eight sledge journeys from vessels of war in latitude about 74° north, and two from the "Fox," in latitude about 72° north. I further observe that, on the first of these journeys, you left the "Enterprise" on the 15th May, 1849, after one winter in the ice, returning to her on the 23rd June, after an absence of 40 days, having travelled 500 miles, at a daily rate of 12 miles, in a temperature varying from $+47^{\circ}$ to zero, and averaging $+24^{\circ}$; your second journey was from the "Assistance," in the autumn of 1850, but limited to 90 miles, and an absence of only seven days; your third journey was from the same ship, which you left on the 15th April, 1851, after one winter in the ice, returning to her on the 4th July, after an absence of 80 days, having travelled 900 miles, at a daily rate of $11\frac{1}{2}$ miles, in a temperature varying from $+52^{\circ}$ to -40° , averaging $+15^{\circ}$; your fourth and fifth journeys were from the "Intrepid," in the autumn of 1852, and limited to distances of 100 and 135 miles, and absences of 18 and 19 days respectively; your sixth journey was from the same vessel, which you left on the 4th April, 1853, after one winter in the ice, returning on the 18th July, after an absence of 105 days, having travelled a distance of 1,230 miles, at an average rate of $11\frac{1}{2}$ miles daily, in a temperature varying from $+51^{\circ}$ to -24° , and averaging $+18^{\circ}$; your seventh journey was from the same vessel, which you left on the 13th April, 1854, with one man and 12 dogs, after two winters in the ice, returning on the 28th April, after an absence of 15 days, having travelled 540 miles, at the daily rate of 36 miles, in a temperature varying from $+23^{\circ}$ to -20° , averaging $+2^{\circ}$; your eighth journey was from the same vessel, which you left on the 15th May, 1859, after two winters in the ice, returning on the 28th May, after an absence of 13 days, having travelled 210 miles, at a daily rate of 16 miles, in a temperature varying from $+44^{\circ}$ to $+5^{\circ}$, averaging $+18^{\circ}$. Your ninth journey from the "Fox," in latitude 72° north, after two winters in the ice, commenced on the 17th February, 1859, and ended on the 14th March, after an absence of 25 days, having travelled 420 miles, at a daily rate of $16\frac{1}{4}$ miles, in a temperature varying from -10° to -48° , averaging -30° , accompanied by two men and 14 dogs. Your tenth journey was from the same vessel, which you left on the 2nd April, 1859, after two winters in the ice, returning on the 19th June, after an absence of 78 days, having travelled 980 miles, at an average daily rate of $12\frac{1}{2}$ miles, in a temperature varying from $+45^{\circ}$ to -24° , averaging $+15^{\circ}$, accompanied by one sledge drawn by four men, and a dog-sledge, with a driver and seven dogs, thus making the total of your arctic travelling to 5,107 miles?—Yes.

not a third supporting ship have insured their safety?—Franklin's expedition sailed from Davis Strait, hoping to come out at Behring's Strait; therefore it would have been necessary to have had a relief ship at either end for them, which was done eventually, though too late. If Sir James Ross's ships had reached Port Leopold in the summer of 1847, instead of 1848, and each expedition had known the direction of the other, it is probable that many of Franklin's crews would have been rescued, although they were more than 400 miles apart; and half that distance was a long way for men to travel who had been three winters in the ice.

3241. Were you chairman of the Arctic Committee, and did you lodge a record of all your proceedings connected with the equipment of the expedition at the Admiralty?—Yes; and all that could be lodged, at the time the Committee broke up, was lodged; and I recommended that all the documents should be collected and kept together up to the time that the expedition sailed, and I know that that was done.

3243. What was the general character of the ice over which your journeys were performed?—Tolerably smooth, but hardly ever free from hummocks.

3244. And what was the depth and character of the snow between the hummocks?—Very seldom more than a foot; from 12 to 15 inches.

3245. Was it soft?—It depends upon the time of the year. Up to the latter end of May it was usually hard; after May it was soft.

3246. In your report I observe that the excess of the distance travelled over the distance made good in the direction of your journeys was generally about one-fifth. Does that excess furnish any fair comparative estimate of the difficulty of the travelling?—No; that was taking it from one encampment to another, one day's march. We found that, after making a journey, adding up all our miles for the whole journey, the actual distance from one encampment to another was about one-fourth or one-fifth less than the number of miles we had to go over to accomplish the whole journey, owing to indentions of the coast line or hummocks, avoiding rough patches of ice.

3247. Would the average temperatures of your journeys, accompanied by a description of the wind, afford any comparative estimate of the severity of the weather?—Yes, I think it would; a very correct one.

3248. In your sledge journeys were any of your men affected by scurvy, or by symptoms which you would now be disposed to consider scorbutic?—No.

3249. To what do you attribute their immunity from scurvy?—The men had been exercised before starting. They started in good health, and they were fed almost exclusively on fresh meat all the time they were travelling; by "fresh meat" I mean not salt meat. I mean pemmican or preserved meats; not salt meats.

3250. Did you carry lime juice on your sledge journeys; and, if so, how and in what quantities was it used?—We carried the usual allowance of lime juice, on the first expedition with Sir James Ross; but then our men were fed on half salt meat and half preserved; we had no pemmican.

3251. And in what quantities was the lime juice used; an ounce daily?—An ounce a-day.

3252. Would you add about your subsequent sledge journeys?—We did not carry any.

3253. Not even in the "Fox" journeys?—No. In subsequent journeys we had pemmican, and therefore we never used lime juice. We always felt that if we gave our men unsalted meat they did not require lime juice.

3254. (*Admiral Sir R. Collinson*.) In the course of your experience snow shoes never would have been an advantage to you?—No, never.

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3255. The snow always being so hard that they were not necessary?—Just so.

3256. I wish you now to give the Committee some impression as to the comparative accommodation on board the previous arctic ships and the present ones, especially with respect to the accommodation of the crew?—The space allotted to the crew of the "Discovery" was rather less than has usually been allowed, because she had a larger proportion of officers.

3257. Was the accommodation on board the "Resolute" or "Assistance" better than that on board the "Discovery" for the men?—The cubic space was rather larger in the case of the "Investigator."

3258. Was the accommodation for the men better on board the "Alert" than the "Discovery"?—She had much more space.

3259. Had she the same lower-deck accommodation for the men that she had as a man-of-war?—No; more space was occupied by cabins as an arctic ship.

3260. Have you any idea what the number of her crew would have been had she been a regular man-of-war?—I should say about 130 officers and men.

3261. Then, although a portion of the lower deck was occupied by cabins, was the accommodation for the men greater than it would have been on the regular service, considering that the number of men was so much smaller?—I should think it was about the same, not greater.

3262. We have here before us the diet-list for the ships which was drawn up by the Arctic Committee. (Appendix 31). Was that diet-list (*handing it to the witness*) a similar one to what you had on previous expeditions?—I think it rather a more liberal allowance than we have had before.

3263. With your experience, do you deem it a sufficient diet to preserve the men in good health during an arctic voyage?—Yes, quite sufficient.

3264. Are you aware whether provisions were saved to any extent? Did the men leave any behind in former expeditions?—I cannot distinctly recollect.

3265. Still, your impression is that the diet was ample?—Yes. I know perfectly well that we were continually changing our winter diet, and adapting it to the consumption of the men, introducing such changes as our means afforded.

3266. I perceive that that diet-list gives about $2\frac{1}{2}$ lbs. of solid food, including bread and fruits and preserved vegetables, to every man per day; do you think that $2\frac{1}{2}$ lbs of solid food is quite sufficient to maintain men in health?—Yes, quite sufficient.

3267. Have you had anything to do with this diet-list (*handing it to the witness*), which is a diet-list of the sledge parties?—I think this is the usual scale of provisions; the only difference I see is, that formerly we sometimes took a pound of biscuit instead of fourteen ounces. I think we always took less tea and sugar than is given here; half the quantity of tea and sugar.

3268. But the diet there given is very similar to that on which you yourself have journeyed in sledges over 5000 miles?—Yes, almost precisely the same.

3269. And is that the diet you would now recommend if another expedition was going to be sent out?—Yes; I do not see how it could be changed for the better.

3270. During the expedition in 1849, the scurvy made its appearance on board both the "Enterprise" and the "Investigator," did it not?—Yes.

3271. Was the attack very severe?—No, I cannot say that it was very severe. I think three or four deaths out of seven which occurred were due to scurvy.

3272. Were many men disabled at the same time?—I recollect at one time, in the "Enterprise," we had 27 on the sick list, out of a crew of 66.

3273. But not entirely with the scurvy?—No, they were not all scurvy.

3274. And had you to send any men to the hospital, on your return home?—Yes, but I cannot speak as to the diseases of the men.

3275. You sent men to the hospital?—Yes, I know that one man died very shortly after our return, but I cannot speak as to the diseases.

3276. Was this occasioned by hard work in sledging, or were the men who had not hard work attacked in common with those who were away on sledge duty?—We had no sledging at all until the month of May; but none of those sledge parties, as far as I recollect, had scurvy at all.

3277. The scurvy then made its appearance during the winter?—Yes.

3278. Can you give the Committee your impression of the cause of the scurvy breaking out as it did on board both vessels?—We were supplied with preserved meats (Goldner's) which were inferior in quality and short weight, and we worked our men a good deal during the winter and early spring, carrying off ballast (a good deal of hard work), and in the "Enterprise" our lower deck was very damp and uncomfortable all the winter. The lower deck of the "Investigator" was much more comfortable than that of the "Enterprise." The "Investigator" lost only one man, whereas the "Enterprise" lost six.

3279. So that the "Investigator" was the healthier ship of the two?—Yes; much so. I attribute the outbreak mainly to two causes, the damp and uncomfortable condition of the "Enterprise's" lower deck and the greater amount of hard work as well as the inferiority of the provisions.

3280. What allowance were the men of the "Investigator" and the "Enterprise" on; was it a reduced or a full allowance?—A full, but not a liberal allowance.

3281. Not so liberal as your subsequent expedition?—Not so liberal, nor so varied.

3282. (*Admiral Inglefield.*) Did the men on board the ships of the expedition in which you were engaged take their lime juice regularly during the summer and winter?—Yes.

3283. Was it taken on the quarter deck, or were they allowed to carry it below?—It was always drunk below; it was generally mixed with the grog.

3284. In that manner you insured its being drunk?—Yes; I think also the men were fond of it.

3285. When you were passing through the middle ice, and making the voyage out to your winter quarters, did you ever give the men a hot midnight meal?—We used on those occasions to give coffee and a little biscuit.

3286. Cooked in the coppers?—Yes.

3287. Have you acquainted the Committee whether you consider that there was any difference in quality or quantity in the provisions issued to the previous expeditions and the recent one?—I am not aware of there being any difference, except in the expedition of 1849, just alluded to.

3288. Have you ever had an opportunity of observing whether the lime juice deteriorates by cold?—No; I am not aware of any deterioration.

3289. When you were engaged on sledge journeys did you carry medical instructions as to the treatment of scurvy, should it break out, and the symptoms, with remedies?—I do not think our medical instructions embraced scurvy.

3290. Did men and officers suffer alike from scurvy?—Yes.

3291. Do you remember how many officers were attacked?—Two officers in the first expedition, in the "Enterprise"; one in the "Fox."

3292. Had you any deaths occur from scurvy?—No deaths of officers.

3293. What did the engineer die of, on board the "Fox"?—Apoplexy.

3294. Not caused by the climate?—No.

3295. Did the officers work like the men at the sledges when travelling on extended journeys, assisting in dragging or steering the sledge?—Not as a rule; they were required to pioneer the way.

3296. But where there was more than one officer,

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the other might have assisted?—Yes; and generally he did so.

3297. Do you remember whether beer and wine were issued in regular rations on board the ship of Sir Edward Belcher's expedition?—The only issues of the kind I recollect were the sugar-beer manufactured on board.

3298. But Admiral Richards says that a quantity of beer was taken out in the ships, besides what was manufactured on board?—I am not aware that any beer was taken out.

3299. He said a certain quantity that lasted the first winter?—It was not so in any ship that I was in.

3300. Lime juice, you have told us, was not carried upon the sledges, excepting upon one occasion?—Yes.

3301. Supposing it were deemed necessary for the future to carry lime juice, can you suggest to the Committee any way in which it could be carried in small quantities, so that each man might have a portion allotted to him, and which he might thaw without the use of fuel by putting it in his sleeping bag. I refer especially to what was given in evidence by Captain Markham, that upon one occasion he was able to thaw a sufficient quantity for four or five men by placing a quart bottle between his legs in his sleeping bag. We have been informed, also, that the quantity as regards measurement per man would not exceed that of a bantam's egg; and I suggest whether it might not be kept in bladders, and so carried and so thawed?—If it were necessary to carry it, I would recommend taking it in very small tin vessels in daily allowances, which you might drop into your cocoa or tea when it is being made in the kettle, and thus thaw its contents.

3302. You see I want to provide for the saving of the fuel, the use of which has been described as a great drawback to carrying lime juice, because it was necessary to take the fuel to thaw it; and by carrying it in these little bladders, if it was thawed, it would not be liable to run away, and if frozen it would not be liable to burst the bladder?—I think that the expenditure of the fuel would be much more upon the water to be mixed with it, than upon the lime juice itself.

3303. Supposing it could be melted in that form, then, do you see any objection to its being administered to each man by putting it into his tea, and then there would be no excessive expenditure of fuel?—I am afraid it would spoil both.

3304. You think it would be unpalatable?—Yes.

3305. Did you collect much sorrel, or scurvy-grass, upon your sledge journeys?—No, none at all.

3306. But yet, in some of your journeys, I think you said you shot a good deal of game?—Yes.

3307. Were mustard and cress raised in the ship which you commanded?—Yes.

3308. In any quantity?—No, very trifling indeed.

3309. We had yesterday evidence given us in a written communication from a man who was captain of a sledge, in which he said that, having considered the question of the outbreak of scurvy, he was induced to believe that it was more due to the un-matured constitutions of the men than to any other cause, and he said that he had heard, which we believe to be true, that it had been a boast on the late expedition that they had no men over 30 years of age, and that from his own experience, having been engaged on three expeditions, men over the age of 30 were better able to endure extreme fatigue than young men, however well developed in their frames, and apparently otherwise healthy; in other words, that men who were older had their constitutions more formed, and therefore were better able to withstand the fatigues and rigours of an arctic life. Is that your opinion?—Not quite. I think that young seamen are less liable to be stricken with scurvy than old ones.

3310. What do you call young seamen? What ages would you select if you were going to command an expedition?—I should say seamen under 25 or 26 are less liable to be stricken with scurvy than seamen who are over 30.

3311. Of course, no one is better acquainted than you are with the arrangements of the ships, and as you had so much to do with the equipment of them, you would be able to acquaint the Committee whether the arrangements were not in every way superior to those of previous arctic expeditions, so far as the experience which has been gained was able to make them so. I allude principally to ventilation, cubic space of the men who were berthed, and all the other general fittings of the ships, stoves, &c.?—I think the arrangement for the accommodation of the crews were superior in the recent expedition to those of any preceding ones, but the cubic space for the crew of the "Discovery" was rather less than I would have wished, which was owing to the large proportion of officers attached to her.

3312. Then you think it a disadvantage on that account to have a large proportion of officers in comparison with the numbers of men carried?—It is a disadvantage to have the space of the crew encroached unduly upon.

3313. You say that in the "Discovery" the men had not sufficient accommodation?—They had less than I would have wished.

3314. And, therefore, we are informed that they sent away eight men for the winter from the "Discovery" to the "Alert," so as to give them more space, I presume; are you aware of that?—I am aware that they had some men lent to the "Alert," but I do not know for what reason.

3315. Can you inform the Committee what was the condition of the health of the men on board the ship in which you had spent two winters when you came on board my ship at Beechey Island?—They were reduced in flesh and in strength, but I am not aware that any of them had symptoms of scurvy.

3316. Have you any opinion to offer with regard to men being acclimatised for arctic service; I mean, whether, if they had spent the first winter in comparative comfort, and had been gradually inured to the service which they had eventually to perform, there would have been less outbreak of scurvy than under the circumstances which actually occurred?—No, I do not think there would have been less.

3317. Then you are not of opinion that acclimatisation has anything to do with immunity from scurvy?—No, I am not.

3318. From your experience, do you consider that temperance men are more exempt from attacks of scurvy or scorbutic symptoms than those who take their grog freely?—All arctic voyagers are of necessity temperance men, although not teetotalers.

3319. I mean teetotalers?—I think the difference is so very slight, that it is imperceptible. I have never noticed any.

3320. We have had evidence that the two or three men who eventually succumbed to the attacks of scurvy were men who were free livers, or of intemperate habits. Do you think that a man of intemperate habits is less equal to combating attacks upon his constitution?—Quite so, of course.

3321. Have you ever heard that the Esquimaux are attacked with scurvy?—I never heard of it.

3322. In Sir Edward Belcher's ship an extra covering of wood was put over the hatchways, by which the condensation upon the beams of the lower deck was in a great measure reduced, and it was possible by such a process to keep the hatchways uncovered, and it has been suggested that a snow-house might be built over the upper deck, and thus more space enclosed on board the ship for the use of the men when they come off the lower deck. Do you think that that would be a good arrangement?—I think it would be an improvement, *if it were practicable*, but in the "Fox" we built snow huts or snow porches over our hatchways.

3323. And left the hatches open?—No, it was in order to give a longer entrance and an additional door, and thereby retain the warmth better.

3324. Do you consider that an issue of lime juice on the sledge journeys would have been the

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means of keeping off scurvy when it broke out amongst the men?—No.

3325. Having once been attacked, you think that no issue of lime juice would have prevented its increasing?—No; I believe that the seeds of scurvy were sown before starting from their ships.

3326. From your knowledge, what is the best treatment of scurvy when once it breaks out. We have had it given in evidence that perfect repose, such as could not be obtained whilst a man was merely being carried upon a sledge, was essential for the recovery of the patients?—I do not think you could treat a man for scurvy away from the ship. He requires comforts, warmth, complete change of diet, and repose.

3327. When you were travelling with dog-sledges, were your dogs frequently attacked with fits?—Yes, not unfrequently.

3328. Some evidence was brought before the Committee yesterday, in which it was said that on some occasions officers, men and dogs (but this was not in the arctic climate) were attacked with scurvy; have you ever heard of dogs being attacked with scurvy?—No.

3329. Have you any suggestions that you could make to the Committee with regard to the present inquiry which have not been elicited from you by the questions which have been put?—No questions have been put to me with reference to the routine to be observed on board, or to the warming and ventilation, or general management of the lower deck.

3330. If you are able to state anything with reference to these matters, the Committee will be glad to hear it, as our inquiry is into the cause of the outbreak of scurvy in the recent arctic expedition?—I attribute the scurvy in the "Enterprise" expedition of 1849 mainly to the damp condition of the lower deck, as compared with the subsequent Government expeditions. This was remedied by appropriating a distinct part of the ship for washing clothes and for bathing, and, where it was practicable, messing the men on an after lower deck separated from the cooking galley; by this means the deck where the men lived was kept perfectly dry.

3331. (*Dr. Fraser.*) Did I rightly understand you to say that you were not quite satisfied with the cubic space on board the "Discovery"?—The original space apportioned to the crew was encroached on by the necessity of building an officer's cabin.

3332. Is it not the case that the question of cubic space is only important, or is to a great extent only important, as bearing upon the facility with which the necessary quantity of fresh air may be supplied to every man?—Yes.

3333. What do you consider the great difficulty with ships wintering in the arctic regions, in effecting the renewal of the air with the requisite frequency?—The necessity for keeping the temperature up to a certain point limits the amount of change of air, otherwise too much ventilation would make the deck too cold.

3334. If that be so, do you think any advantage would be gained by elevating, to some extent, the temperature of the air admitted from the outside to renew the foul air between the decks?—Yes, inasmuch as you could increase the amount of ventilation without unduly lowering the temperature.

3335. For instance, by conducting the air from the outside to some chamber in contact with the heating stove, before it is distributed into the room to be supplied with fresh air?—Yes; and to a limited extent that has been tried with the Sylvester stove.

3336. Do you think that a system of that description could be more generally and extensively applied in the ventilation of arctic ships?—Yes, it could, but I do not think it is necessary. We have found that the mere opening and shutting of doors, to let people up and down, is quite sufficient to keep the air pure, the difference of temperature being so great.

3337. We have already had evidence that the air in both the ships forming the last arctic expedition was, at any rate at times, extremely impure, so that that means of renewal was not, in their case, sufficient?—

There always are stove pipes to carry off heated air, so that a change is constantly going on, irrespective of the doors being open or shut.

3338. It was proved, however, that the change was not going on with the requisite frequency to maintain a sufficiently pure atmosphere; in that case, if the means which were adopted were not sufficient, would it not be an advantage to apply the means to which we have already referred, admission of heated air, if this method would affect a more frequent renewal of the air?—Our practice has been to keep the temperature of the lower deck uniformly between 50° and 55°. When it rose above 50°, the man on watch was ordered to open a door until it fell below 50°, when it was closed, and we generally found that sufficient to meet all the requirements; in remote corners small ventilating tubes were sometimes put through the deck.

3339. You mean that, in those cases which you refer to, no obvious impurity of the air was observed?—Just so; no obvious impurity.

3340. Was the air ever analysed in those cases?—I think not.

3341. I think you have told the Committee that you took part in eight sledging expeditions from ships of war, and in two from the ship "Fox"?—Yes.

3342. As a general rule, the distance which you made good in these sledge expeditions was very much greater than the distance made good in the sledge expeditions of the recent arctic expedition?—Yes. I believe that is mainly owing to the rougher character of the ice that they met with, and the necessity for travelling three or four times over the same road.

3343. In a rough manner, that difference indicates very much less physical work, does it not, on the part of your sledge crews, as contrasted with the sledge crews of the "Alert" and "Discovery"?—No; I think not. I do not think that is a fair inference to draw from it; we never left off till we were well tired.

3344. It is merely a question of the difficulties being greater in the one case than in the other?—Just so, and therefore limiting the distance travelled.

3345. Still it seems to prove that the physical exertion required on the part of the men of the "Alert" and the "Discovery" was always the greatest that they were capable of effecting, whereas it is quite possible that the men in your expeditions were not worked up to their greatest capability; is that so, do you think?—I think that, throughout the Franklin search, the men were always worked up to their greatest capability.

3346. Some of your expeditions were made in dog-sledges, were they not?—Yes.

3347. I think you have told us also that only in one of those expeditions did you carry any lime juice?—Yes, only one.

3348. And the reason why you did not carry it in subsequent expeditions, was because you had pemmican, I think I understood you to say?—Yes.

3349. And you did not therefore think that lime juice was requisite?—Just so.

3350. Will you allow me to quote a passage in your narrative of the discovery of the fate of Sir John Franklin and his companions, published in 1860. In Chapter 17 of this narrative, I see that the following passage occurs: "And yet Hobson's food throughout the whole journey was pemmican of the very best quality, the most nutritious description of food that we know of, and varied occasionally by such game as they were able to shoot. In spite of this fresh meat diet, scurvy advanced with rapid strides." Was this pemmican referred to in the passage I have just read, the same or a similar preparation to the pemmican which was used in the recent arctic expedition?—I think it was precisely the same.

3351. I think we have had it in evidence, however, that more than one variety of pemmican was used in the recent arctic expedition?—The only difference was, that one kind of pemmican had a little sugar added to it.

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3352. Do you know exactly how the pemmican that was used in the recent arctic expedition was prepared, do you know the process of preparation?—No, I cannot tell you with accuracy. Before we leave this subject, I wish to observe that Hobson actually had scurvy when he started on this expedition, although we were not aware of it at the time.

3353. I would refer you to Saturday, the 2nd of July, when you appear to have returned from some expedition yourself, and your first enquiries were about Hobson, and you found him in a worse state than you had expected; was the illness on this date also scurvy?—Yes.

3354. I do not refer to this passage, however, on account of the mention of Captain Hobson especially, but because a few lines further on you say: "Christian had shot several ducks, which, with preserved potato, milk, strong ale, and lemon juice, completed a very respectable dietary for a scurvy-stricken patient." This, then, was your opinion of a respectable dietary for scurvy?—Yes.

3355. On the same date, I observe that a death is noted to have occurred from scurvy, that of the ship's steward, Thomas Blackwell, and in connection with the cause of the scurvy in the case of this man I will, with your permission, quote from the same book a few lines further on: "When too late, his shipmates made it known that he had a dislike to preserved meats, and had lived the whole winter upon salt pork. He also disliked preserved potato, and would not eat it unless watched." That, so far as you know, represents the facts antecedent to the illness of this man?—Yes.

3356. About this time you had several other cases of scurvy, had you not?—We had some.

3357. I think, for instance, that Captain Young became ill after a sledge journey, or during a sledge journey?—I do not think that that was scurvy. We had only five cases in all, that I know of.

3358. Amongst those five, probably the case of Harvey may be included?—Yes.

3359. What was the quality of the lime juice supplied to you in this expedition, speaking generally?—Nearly all of it was supplied to us by the Admiralty, and was of the best quality, and freshly made.

3360. I ask you that in connection with a passage applying to its quality, on the 8th of August, in your journal, where you say you had to use but very indifferent lemon juice?—Yes; if I recollect rightly, that lime juice had been obtained from the whaling vessels, and was very weak.

3361. But previously to August the 8th, you also note, "the issue of lime juice has been reduced to the ordinary allowance of half-an-ounce daily"?—Yes; that was a temporary arrangement at a time when we were obtaining some fresh supplies of game; also whenever we issued sugar-beer we stopped the issue of lime juice altogether.

3362. You did not, however, on this last expedition meet with so much scurvy as you did when with the "Enterprise," I think I understood you to say?—No; nothing like so much; there were only 5 cases in all in the whole period of two years.

3363. You have told the Committee that you had at that time but a limited quantity of inferior preserved meat; what vegetable food had you at the same time?—We had preserved potatoes, carrots, and mixed vegetables, including beetroot and cabbage.

3364. Was there any scarcity in the supply of vegetables as in the case of the meat?—They were also about one-sixth short of their weight.

3365. I think you attribute the occurrence of scurvy to the scarcity and the bad quality of the meat, and the short quantity of vegetables along with the hard work and the damp lower deck; is that so?—Yes; I think that it was mainly due to the unhealthy condition of the lower deck.

3366. And that was caused by its dampness?—Yes.

3367. Of course you know that scurvy may occur when there is no dampness, in fact, when there is

excessive dryness in the surroundings, in a parched-up country, for instance?—I am aware that Commander Cameron was laid up by scurvy in his recent African tour; but dampness in an arctic climate is one result of insufficient ventilation.

3368. It was a frequent occurrence on a very extensive scale, was it not, during the hottest seasons in the Crimean War also?—Yes, I have heard so.

3369. Have you formed any opinion as to the cause of the outbreak in the recent expedition?—I am not in a position to answer that, for I really do not know what their internal arrangements were for maintaining the health of their crews; I only know of the accommodation I provided for them.

3370. Still I understand your opinion is, that the seeds were sown before the men left the ships?—I think so.

3371. The scale of diet, and in fact the general arrangements, on board ship, had been matters of consideration by the Admiralty Arctic Committee, had they not?—Yes.

3372. (*Dr. Donnet.*) On your return from your lengthened journeys, were not your men subject to much wet from the thaw, and did they not suffer inconvenience from this wetting?—Yes.

3373. Did this inconvenience affect their health?—It brought out rheumatic pains, but I do not think it affected their general health.

3374. Did you give any consideration to these pains, and think them premonitory of scurvy?—No; on one of those occasions a medical officer, Dr. Bradford, was travelling with me.

3375. Did he express any opinion about the nature of those pains?—Simply that they were rheumatic affections arising from the wet.

3376. In your travelling around King William's Island, did you meet with ice in any way like that which was met with in the northern seas by the late arctic expedition?—We met with some very heavy ice, and with hummocks often 20 feet or more in height, but I fancy they were not so difficult to travel over as those the late expedition met with.

3377. Did this hummocky state of the ice add to the men's fatigue?—Yes, very much indeed.

3378. And was this fatigue in any degree injurious to your men?—We only had to pass over this kind of ice occasionally, but I think any long continuance of it would have knocked them up.

3379. Was the cold experienced at the time great?—No, not more than 10° or 15° below zero.

3380. Have you formed any opinion about the influence of the absence of light upon the system in your various expeditions?—No, not beyond observing that it exercises generally a depressing effect.

3381. Was this depression physical or mental?—The depressing effect physically was general, the mental depression was partial, depending upon the individual temperament.

3382. Do you think that this protracted absence of the beneficial rays of the sun's light had any appreciable effect towards producing scurvy in the men of the "Fox's" expedition?—Yes; it must have had an effect of the kind.

3383. What was the system of ventilation which you adopted on board the "Fox"?—Simply detached heating stoves, to maintain a comfortable temperature. The stove pipes and the hatchways afforded sufficient means of changing the air, with the addition of one or two small tubes up through the deck for occasional use.

3384. I believe, in the other expeditions to which you belonged, the system of warming was by means of the Sylvester stove; had this system a superiority over that which was adopted on board the late arctic ships?—Sylvester's heating apparatus was used in the expeditions of 1848 and 1850, for the purpose of warming the officers' cabins, but it had no effect upon the ventilation of the lower deck. In 1852 Sylvester's apparatus was removed from the "Intrepid," and detached stoves substituted, which proved to be a better means of warming the ship.

3385. To what journey do you allude, in which lime juice was carried?—The expedition in 1849.

3386. Did I rightly understand you to say that lime juice was required when salt meat was issued, and none when pemmican was taken?—That is the principle which has always governed our use or disuse of it.

3387. Do you consider, therefore, that pemmican contains in itself powers whereby men when taking it are enabled to resist an attack of scurvy?—I think so. Sir John Richardson in his arctic journeys used pemmican and did not use lemon juice.

3388. Do you know what the results of this disuse of lime juice in the sledge journeys were; had he any case of scurvy?—No; not any.

3389. Had he a supply of vegetables?—No; I believe his ration consisted of 2lbs. of pemmican and a $\frac{1}{2}$ lb. of flour only.

3390. Are you able to inform me whether the men of his expedition used scurvy-grass, sorrel, or other antiscorbutics in this sledge journey?—No; I cannot say.

3391. I believe that in the outbreak of scurvy in 1849, on board the "Enterprise," your men were much improved by a supply of fresh meat, and that the disease was checked in its progress by this supply; can you inform me whether lime juice formed part of the treatment adopted by the medical officer?—I am not aware whether the ration of lime juice was increased or not, but I am aware that a large supply of sea birds obtained during the summer, and amounting to 2,100 lbs. of fresh food, was very beneficial.

3392. I believe you attach importance to the value of fresh meat as an antiscorbutic, and I likewise know from information that you brought your men back to Melville Island in very good health in the expedition of 1851, in which, I believe, you were absent eighty days away, and during which you accomplished 900 miles; did you attribute this state of the health of your men to the fresh meat obtained in your expedition?—Yes; it was a very great assistance in maintaining the strength and the health of the men.

3393. Did you manage to get musk ox or reindeer?—We got four musk oxen, and one reindeer.

3394. Were you able to cook the musk-ox beef, or did the men eat it half cooked?—We were able to cook a considerable portion of it; we did not eat any of it raw, or half cooked.

3395. In the issue of lime juice as a ration in the service generally, I believe you are of opinion that the object is to strengthen the men against an attack of scurvy, in the same manner that we give quinine wine to fortify them against malarious fever; when we take into consideration the dangers to which men on a sledge journey are subjected, towards contracting scurvy, would you consider lime juice a necessary article of diet in any future expedition?—I think it would be desirable to use it where you are unable to obtain game, but with game I think it would be quite unnecessary.

3396. Whilst serving as Commodore in the West Indies, you had an opportunity of observing the freedom from yellow fever which some years possessed over others, and you may have formed an opinion that causes, obscure to us, were in operation to produce those effects; do you think that similar conditions may obtain in the arctic seas; I ask this question because your experience both in the West Indies and

in the Polar Seas extended over several years?—No; I think the temperature of an arctic climate does not admit of it.

3397. Have you any suggestion to make towards the improvement of the arctic diet, whether condensed milk, or more preserved fruit, or other articles, might be added?—I do not think that we know how to materially improve it; but I think it important that it should be varied as frequently as possible. I can only suggest some change in the direction of less salt beef, and more preserved fruits and vegetables.

3398. Can you tell me whether the scale of diet recommended by the Arctic Committee was not based on the idea that a good deal of game would be obtained?—No; it was quite independent of any supply of game. That was regarded as altogether additional.

3399. Your expedition in the "Fox" consisted of about the same number of souls as Dr. Kane's, and both were absent about the same length of time; but you had but one death from scurvy, whilst three died in Dr. Kane's expedition. To what do you attribute this death in your case?—To the man's wilful neglect of all the ordinary means of preserving his health. He had lived all the preceding winter on salt meat; he would not eat preserved potatoes, or change his clothes, or take any exercise, unless he was forced to do so.

3400. In the selection of the men of the "Fox," did they undergo any medical examination?—No.

3401. How were they chosen?—Most of them had been previously in the arctic service; with one or two exceptions, the whole had been men-of-war's men of known good character.

3402. Did you take condensed milk in any of your sledge journeys?—Only to a very limited extent, and that rather as an experiment than real use.

3403. (*The Chairman.*) What size of vessel and number of crew do you consider best adapted for arctic expeditions?—If a steamer, a vessel of about 600 tons; and unless she has a crew amounting to 60 men, her sledging operations would be very limited.

3404. If two vessels are dispatched on an arctic expedition, would you recommend their remaining together, and, in that case, having a third vessel in support?—Of course it would be better to have the two ships together at the most advanced point, where combined operations were required, such as extensive sledging, but to ensure their safety it entails the necessity for a third vessel in the rear.

3405. Can you furnish the Committee with a vertical fore and aft section of the "Alert" and the "Discovery," showing the mode in which the decks, and holds, &c., were occupied, together with the cubical contents of the officers' cabins and the cubical contents of the lower decks, and also a deck plan?—Yes, I will furnish it. (Appendix No. 22).

3406. (*Admiral Sir R. Collinson.*) What do you think the proper weight to be dragged by a sledge crew per man?—It depends very much upon the size of the sledge. With short sledges, I think 200 lbs. is quite heavy enough. With the largest size sledge that we make, which is 14 feet long, we can go up to 230 or even 240 lbs. a man; but this, of course, must be modified by the nature of the ice to be travelled over.

3407. What amount would you give a dog to drag?—About 100 lbs. Two dogs are equal to one man.

The witness withdrew.

CAPTAIN WILLIAM ROBERT HOBSON, R.N., examined.

3408. (*The Chairman.*) From the return which you have been good enough to furnish to the Committee, I observe that you made one sledge journey from the "Rattlesnake" in latitude 60° north, and two from the "Fox," in latitude 72° north. I further observe that on the first of these journeys you left the "Rattlesnake" on the 9th of February, returning to her on the 27th of March, after an absence of 47

days, having travelled 500 miles, at an average daily rate of 10 $\frac{2}{3}$ miles, with four men, eleven dogs, and two sledges. On the second you left the "Fox" on the 25th October, 1858, after one winter in the ice, returning to her on the 6th of November, after an absence of 13 days, having travelled 200 miles, at an average daily rate of 15 $\frac{1}{2}$ miles. On the third, you left the "Fox" on the 2nd of April, 1859, after two

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winters in the ice, returning on the 14th of June, 1859, after an absence of 74 days, having travelled 1,100 miles, at an average daily rate of $14\frac{1}{2}$ miles, with five men, seven dogs, and two sledges?—Yes, that is correct.

3409. What was the general character of the ice over which your journeys were performed?—We kept very much along the land. There is a great deal of broken-up ice on the seashore, but inside that broken-up ice, where the ice is forced upon the land, you can generally find a comparatively smooth road. The ice will ground according to its force and its depth, and, wherever it touches the ground, it leaves inside the broken-up ice a comparatively easy way so long as you are following the coast line. We had, in crossing the channel between King William's Land and Cape Felix, very heavy ice to pass through, and very difficult to find a way through, in fact.

3410. What was the depth and character of the snow, as a rule?—I think that would be almost an impossible question to answer, because wherever it is driven against a cliff, or against anything, it will pile up to any depth, but if the wind is sweeping the surface of the ice you may find it one foot or six inches, or even less; it is absolutely driven in the shape of a snow-drift before the wind.

3411. Was there much wind during your journeys?—Yes, at times there was a good deal of wind.

3412. And that aggravates the difficulty of travelling very much?—It intensifies the cold to an immense extent.

3413. In your sledge journeys, were any of your men affected by scurvy, or by symptoms which you would now be disposed to consider scorbutic?—We all were.

3414. Did you carry any lime juice with you?—None.

3415. Why did it not form part of your sledge equipment?—So far as I know it never had been sent, and there would be great difficulties in utilising it, if sent; the difficulty would be that the lime juice would be frozen into a mass. It is very difficult to get sufficient water even to quench your thirst in travelling; you are dependent upon the stearine which you carry with you for thawing the water for tea and cooking, and so on, and I think that it would have been extremely difficult to find means of thawing the frozen lime juice. I think that the men who formed the sledge parties would have very much disliked having it put into their tea. I am speaking, of course, practically, as I think myself that they disliked having it put into their tea or grog, or anything else, and that, therefore, there would have been great difficulty in carrying lime juice. If they had taken it in a frozen state and sucked it, I think that it would have greatly increased the thirst that you always do experience in extremely low temperature. One gets as thirsty in very cold weather as one does in tropical weather; and I think, for that reason, it would have been very difficult to carry lime juice and to utilize it.

3416. (*Admiral Sir R. Collinson.*) How many winters did you pass in Behring's Straits?—One.

3417. Had you any case of scurvy?—None.

3418. What do you attribute that to?—The fact that we were able to get any amount of fresh meat, reindeer, and ptarmigan, and so on.

3419. Consequently, when you said that you were all affected, you alluded to your "Fox" journey alone?—Yes; there was no sign of any scurvy in the "Rattlesnake" when I met you in Behring's Straits, either in the "Plover" or "Rattlesnake"; it was unknown. I was in the "Rattlesnake" during the winter, and then changed to the "Plover."

3420. In your autumn journey from the "Fox" you had a considerable difficulty in getting along the coast, had you not?—Very great.

3421. Will you describe what happened?—I was sent by my chief to lay out depôts of provisions as far as I could along the line of march that we were to follow. My great difficulty was that having had a long day's march, travelling a coast where the ice was piled up against it so far that we could not get

through, with a party of, speaking from memory, nine men encamped upon sea ice, very shortly after our having encamped, it was found that the ice had broken away from the shore, and before we could do anything else, before we could attempt to get to the shore, there was a lane of water about 11 or 12 yards between us and the shore; it was therefore impossible to get to the land, and the only thing we could do was to encamp on that piece of ice that we were driving on; it was blowing a gale of wind off shore, with a temperature of about 19° below zero, and we drove away at the mercy of the wind, on the piece of ice that we were on until it began to break up; at last we found ourselves on a tongue-shaped piece of ice, about 100 yards in length, and possibly 40 yards in breadth. As we drove out and got sea room, this thing broke up; we drove against another piece, and, speaking from memory, it was 48 hours before we got to the shore, somewhere about ten miles from where we left it.

3422. Was there great exposure and labour to the men?—Very great indeed.

3423. Had it any effect upon their health?—Not the least, I think, at that time.

3424. You returned, then, to the ship from that journey without any signs of scurvy?—Without the least; we were only a few days away. I think I returned 19 days on that journey. I think that was the time we were away.

3425. On the spring journey, when did you first of all feel your debility coming on?—Before I left the ship.

3426. And were you ever entirely incapacitated from walking?—I certainly was for a time, but never for a whole day. I was weak, and I had to sit on the sledge at times during the day's march. I suppose I may say really what did occur, that I at times fainted from the effects of scurvy, but I never was so debilitated as not to be able to do a part of a day's work in any day of my journey; but I did at times faint, and had to be picked up and put on the sledge.

3427. Was anybody else as bad as you were?—No one in my travelling party.

3428. But I understood you to say that you were all more or less affected?—Yes.

3429. Can you give the Committee any opinion as to the cause why scurvy broke out with you?—I can scarcely say that scurvy did break out with us. I said that the men were debilitated, that they lost stamina. There was no cause that I know of, except the fact of not being able to get really fresh meat and fresh vegetables.

3430. Did you get any fresh food during that expedition?—I think I said in my report of my sledge journey that we killed one bear and five ptarmigan, but we certainly got a few reindeer and a few wild fowl, and particularly seals. After our return, we got a good many seals in the spring and autumn. During the time that we were on my sledge journey we got nothing but one bear, and I think four or five ptarmigan.

3431. You have expressed rather a doubtful opinion as to whether it was scurvy with which you were attacked; what is your opinion now?—Certainly that I had scurvy. I did not give myself credit for scurvy when I first found that I was not so strong as I thought I should be, but there is no doubt about it, that it was scurvy that attacked me.

3432. (*Admiral Inglefield.*) Did the men in the ships in which you were engaged take their lime juice regularly, both summer and winter?—It was issued always on board ship; I really cannot tell whether they took it.

3433. But was it drunk on the quarter-deck or carried below to the messes?—It was served out to them at their messes.

3434. And mixed with the grog?—No.

3435. Did the men in your parties use tobacco much?—Yes.

3436. Smoking and chewing?—Very little chewing; but I think they always were very glad to smoke their pipes when they came in, after getting into the

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tent, and whenever we halted for a rest the men used to smoke their pipes.

3437. Do you think that men who have been injured to one winter are better suited or less well suited for work?—Less, certainly.

3438. Have you formed any opinion as to the proper age of men for arctic service?—I should say the younger the man the better. Let him be matured, let him be twenty-three or twenty-four. I should say between twenty-five and thirty-five a man would be best fitted for work of that sort.

3439. Was there much sorrel and scurvy-grass got where you went?—No, none at all.

3440. You have seen, I dare say, a good deal of the Esquimaux in Behring's Straits?—Yes.

3441. Have you seen what they call the Tchutski Indians?—No; I have seen a good deal of the Esquimaux.

3442. Do they ever have scurvy among them?—I never heard of it.

3443. Have you drunk much lime juice yourself?—No.

3444. Not upon your sledge journeys, or on board ship?—None at all on my sledge journeys; on board ship very little. Perhaps I ought to say that I imagined that our supply was rather short, and that I did not take my fair allowance of lime juice on board the "Fox."

3445. And there you did suffer from scurvy?—I did, indeed.

3446. You had only scurvy in the "Fox," not in the "Rattlesnake"?—No, never in the "Rattlesnake."

3447. Have you any suggestions which you can make with regard to the present inquiry which have not been already elicited from you by questions which have been put?—My idea is, that in future travelling parties lime juice might be carried in the form of capsules. I am not quite sure whether the lime juice would be so strong a solvent as to destroy gelatine, that is a question for a chemist; but I think that it might be carried in that way and swallowed as a pill. I have asked one or two men, who are not particularly good chemists, whether the extreme acid would destroy the gelatine. I cannot tell. I should suggest, if it can be carried in that form, that it would be the best way that you should so swallow it, and there would not be the necessity of thawing water.

3448. Then you think that if carried in a concentrated form it might be administered daily to the crews without an increase of weight to the sledges?—Yes, that you might put it in the form of a cart-ridge case.

3449. It is a question, you say, for a chemist to decide, whether the lime juice can be concentrated, so as to retain all its antiscorbutic qualities, and carried in a much lesser form?—My own doubt is, whether the acute acid will not destroy the gelatine case.

3450. (*Dr. Fraser.*) I understand you to say that you had no scurvy while you were connected with the Behring's Straits expedition?—Yes.

3451. Nor was there any scurvy in connection with the crews of that expedition?—None at all.

3452. You had an abundant supply of fresh meat?—Yes, and many reindeer killed and ptarmigan shot, and so on.

3453. What vegetables were you supplied with?—Precisely what is given now. We had preserved potatoes and preserved vegetables.

3454. Were you employed in sledging while on that expedition?—Yes, I was away 47 days. I crossed the land from where we wintered to Kotzebue Sound.

3455. What crew had you?—I had two men and an Esquimaux guide then.

3456. Four in all?—Four in all.

3457. A dog-sledge, I presume?—Yes.

3458. And what rations had your crew then, the board ship ration or a special ration?—The rations from the ship, but we got a great deal of reindeer flesh. If you are speaking of provisioning the sledge, we were provisioned simply from the ship; we had pemmican then.

3459. And what vegetable, the ordinary ship vegetable?—No; Edwards's tin of potatoes.

3460. And did you carry lime juice on the sledging party?—None; I never have.

3461. I suppose that, as a general rule, the physical work in a dog-sledge is not so much as in a man-sledge?—Well, it is quite as great. Of course, we did not ride on the sledge; we were dragging with the dogs with a belt over the shoulder, and working at the sledge. We had the dogs in the same sledge, but it was a case of absolute constant drag, always working, officer and man working together.

3462. What was the advantage of taking your dogs?—Because they dragged a part of our weight for us; they were not sufficient to support our whole weight.

3463. If the dogs had not been there, the work would have been greater?—Yes, but we weighted a man to drag 200 lbs. and a dog would drag 100 lbs. The dog's work was 100 lbs., that is to say, the weight on the sledge to each dog was 100 lbs.; the weight for a man to drag was 200 lbs. In speaking about dogs, I think that I should explain, that it is only over smooth ice that they can do work in that way. They are the most troublesome creatures to deal with in rough ice. The moment they find a check they will turn round and look you in the face, and you have by main force to move the sledge yourself and to put them straight before they will do a thing. If there is a check of any sort to the sledge, if the sledge runs down between a couple of hummocks, or something of that sort, the dogs will simply sit down and look at you, and till the sledge is started for them they will not move; you cannot get them to move one pound till you have done that for them.

3464. May I take it for granted that you derived some assistance from the dogs?—Very great, undoubtedly.

3465. And had you not had dogs, your work would have been harder, would it not?—Certainly; we could not have done the work without the dogs.

3466. You were also employed in the expedition in search of Sir John Franklin, I think?—Yes.

3467. On board the "Fox"?—On board the "Fox."

3468. There seems to have been a scarcity of lime juice in the latter case?—Well, I cannot say so. I think that I said before, in giving reasons for my having scurvy, that I did not take lime juice. There may have been a scarcity; we might well have had more.

3469. You admit that there was scarcity, do not you?—Yes, I must admit that there was.

3470. Are you able to say whether or not the full allowance of lime juice was regularly consumed by the crew of that ship?—I cannot say; it was given to the men; it is impossible to say whether they took it or not; my belief is that they did, and would have taken more if they had had it.

3471. The full allowance was always served out?—Yes; it was always given.

3472. Had you any suspicion of the quality; because I observe from Admiral McClintock's narrative that he did have suspicion of the quality of the lime juice, and we have learnt that his suspicion was due to his having known that the lime juice had been frozen?—I had no suspicion at the time nor have I now. It is simply my own individual belief, that every time that lime juice is frozen and thawed again it loses a part of its qualities.

3473. Why do you think so?—I think that a certain amount of the essential essence of it is driven out every time that it is frozen.

3474. What is the "essential essence" to which you refer?—The vegetable acid. You must not question me as a chemist, because I do not know; but I know this, that every time that salt water is frozen and thawed again you find that there is a certain amount of the ingredients thrown out.

3475. You have not arrived at this opinion from any observation you have made with frozen lime juice as compared with lime juice that had not been frozen,

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have you?—No; I am only giving an individual opinion.

3476. You had several cases, had you, of scurvy on board the "Fox"?—I myself had scurvy badly. We lost one man from scurvy, and my opinion is, that more or less the whole of our ship's company were touched with it.

3477. During your second year?—The second year. We were driving in the ice the first year; the second year we had all the scurvy that occurred.

3478. And in your own case, of which you had of course satisfactory evidence, the ration of lime juice was not regularly consumed?—I did not consume it myself.

3479. You cannot speak positively in reference to the crew, can you?—If I am obliged to say positively, as a matter of fact, I cannot say whether they absolutely drank their lime juice, but that it was within their reach, and I believe they did.

3480. And you yourself became ill on board ship?—No; when I was travelling. I had a suspicion that there was something wrong with me before I started. I never supposed until I was nearly back to the ship that there was anything like scurvy about me. I never dreamt of scurvy.

3481. Now, in the Behring's Straits expedition the sledge parties, I understand, were supplied with pemmican?—Yes, we had some, but so ample was the supply of game that no stress can be laid on it in considering the diet.

3482. In the sledging expeditions of the "Fox," they were supplied with pemmican?—Yes, certainly; it was our principal food.

3483. In which of the sledging parties did scurvy occur, that of the Behring's Straits or the "Fox," expedition?—The "Fox" expedition.

3484. That is to say, notwithstanding a liberal supply of pemmican, scurvy occurred in the sledging parties of the "Fox"?—Yes, certainly, that was so, I had it badly enough, and most of our men had it.

3485. What vegetable food had you on the sledge journey of the "Fox"?—We had preserved potato, and, if I remember rightly, onion powder.

3486. Are you acquainted with the sledge party dietary of the recent expedition?—I have not gone into that.

3487. I will show you this diet list (*handing the same to the witness*), and perhaps you would, after looking at it, inform me if it resembles that of the dietary used by yourself in the sledge parties of the "Fox" expedition?—I think it is precisely the same.

3488. Had you more than one, or only one sledge excursion from the "Fox"?—I had three.

3489. And which one was it in which you had scurvy?—The last; the long spring journey.

3490. Was that a dog-sledge, or a man-sledge?—Dog and man.

3491. What was the number of your party?—We were six in all, four men, an Esquimaux and myself.

3492. And the whole party were attacked, I think you said?—Yes; but none as severely as myself.

3493. Were they all attacked during the sledge journey?—Yes; that is to say, as I think I said in my paper, they were debilitated when they came back.

3494. Did they start in good health?—They started in good health.

3495. There was no obvious symptom of scurvy when they started?—Not the least, nor was it so severe but what they could work. Even in my own case, though mine was a severe case, I was able to get about immediately afterwards, after getting to the ship. The moment we got fresh meat, and change of diet, we began to get better.

3496. Are you acquainted with the scale of victualling on board ship in the recent arctic expedition?—No; I am not (*a scale of victualling was handed to the witness*). This is a great mistake, that "game in considerable quantities may be obtained"; it is quite a mistake to count upon it at all.

3497. But you cannot tell me at all if this scale of

victualling corresponds with the scale of victualling on board the "Fox"?—Yes; it does.

3498. Then you are sufficiently acquainted with this scale of victualling to say that it is nearly the same as that on board the "Fox," are you?—Yes; I think it is as nearly as possible. There may be some slight differences.

3499. Generally speaking, it corresponds with that scale?—Yes.

3500. And it is a scale which was used on board the "Fox," with no decided case of scurvy having occurred?—On board ship, none except the case of the ship's steward. Of course one does not like to malign a dead man, but he brought the thing upon himself pretty much.

3501. Why?—He was an unsteady man. I think I said in my remarks that we could not induce him to take exercise.

3502. What was the name of that man?—Thomas Blackwell.

3503. That is the case regarding which we have obtained some information from Admiral McClintock, I think. Was the same diet scale made use of in the expedition at Behring's Straits?—No.

3504. It was quite a different diet scale?—Quite a different one.

3505. You therefore had six cases of scurvy in your sledge party, while that sledge party was consuming rations identical with those in the scale of dietary of the recent arctic expedition?—Precisely, I think. I must say that, except in my own case, the cases of scurvy were very slight; they yielded at once to treatment.

3506. What treatment?—Simply being given fresh meat, and we were able to shoot a few seals and wild duck, and to give the men a change of diet. I should say that it yielded simply to change of diet.

3507. Was that when they returned to the ship?—When they returned to the ship.

3508. In that treatment would a ration of lime juice be included?—Undoubtedly. I cannot say, of course, whether their recovery was due to that.

3509. Had you during your sledging expeditions in general much difficulty in obtaining water?—Every difficulty. The only water that we obtained was what we were able to thaw; we never saw water.

3510. Did you suffer from the want of water much?—Very much.

3511. In what way?—Thirst.

3512. Did you ever make any kind of estimate of the total amount of water which you drank per diem during these expeditions?—No; I never made an estimate, but I could almost say that it was none; it was a great pull if you could find a piece of drift wood and light up a fire and melt some water in the middle of the day. What we consumed was simply our tea and cocoa; there was no means of getting water.

3513. And how much water was there in the tea and cocoa?—I should say about a quart a-day.

3514. Did you, yourself, ever notice any bad effects following the eating of snow, and what were they?—None; but our men did not do it much.

3515. And what was the effect that you dreaded from eating the snow?—Increase of thirst, I think.

3516. (*Dr. Donnet.*) What was the highest parallel of latitude that you attained in the "Rattlesnake" and the "Plover"?—We wintered in 64° north, just to the South of the Arctic Circle, and the highest latitude that I attained was Chamisso Island. I cannot tell the latitude without looking at the chart.

3517. Did I understand you to say that you had no scorbutic symptoms in this expedition?—None at all.

3518. What do you attribute this absence of scurvy to?—The fact of our being in a comparatively low latitude, and the fact of our being able to get any amount of fresh meat. We killed reindeer and ptarmigan, and were not living on ship's provisions.

3519. Was the nature of your sledge expedition hard when you went to Chamisso Island?—Yes; a very hard one.

3520. What was the nature of the ice in that

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expedition?—To a great extent we were not travelling over sea ice, we were crossing country.

3521. What was the nature of the ground?—Following the course of the river, crossing a piece of ground between the source of the river and the seashore on Kotzebue Sound side, and then following the coast line until crossing just about 15 or 20 miles between the land and the Island.

3522. Can you mention what amount of fresh meat, birds and fish you obtained during the time that you were in Port Clarence?—There was an ample supply to be got from the Esquimaux.

3523. As much as you wished?—Yes, and we might have shot any amount if we had been allowed to. I should describe the supply as being ample.

3524. Then you may attribute your immunity from scurvy not only to the low latitude, but to the quantity of fresh meat you were able to obtain?—Yes.

3525. How long had you been on board the "Fox" before any symptoms of scurvy declared itself?—I do not think that anyone suspected scurvy until we started for our long journeys in the second spring; I think there was no suspicion of scurvy up to that time.

3526. In your own person, you suffered from a debilitated state. I believe you said you were not aware of its being scurvy at the time, but that, from what you now know, you consider it was scurvy?—There is no doubt about that. I am perfectly well aware of that, but when I first, in travelling, found I was not able to do what I thought I should do, it never occurred to me that it was scurvy.

3527. Can you give the Committee a description of your feelings at the time when you were in this state?—The first thing was, that I found myself extremely stiff; my legs were extremely stiff, and I found, on looking at them, that they were blackening, and on touching them I found that my fingers pitted, that there was no elasticity in the flesh. I knew so little of scurvy at that time, that I did not at all attribute it to scurvy; I attributed it to a very heavy fall that I had had some time before, and then gradually as I went on I found myself less and less able to do my work day by day, and, so far as scurvy attacked me, it was absolute weakness. I did not break out into sores or blains; my teeth did not loosen, or any of those symptoms occur, but any exertion that I had to make would lead to fainting; I used to faint at any sort of exertion I made. I was at last obliged to succumb, and sit on the sledge for the greater part of the last few days of the journey.

3528. Had you these fainting fits whilst away on sledge travelling?—Yes.

3529. Amongst the other symptoms, did you remark any swelling of the gums?—No, none.

3530. Do you know whether your breath was offensive?—That is more than I can say; my neighbours might have answered that question.

3531. You say that you never took lime juice; had you any reason for not doing so?—For a considerable time I did not take lime juice, because the supply was, as I thought, short; and, if I am obliged to say really what I mean, at the time I thought that I was strong enough to stand anything, and I gave up my allowance of it.

3532. Why did you not take it?—It was rather short, as I thought.

3533. It was self-sacrifice, then, on your part?—You may call it so, if you like.

3534. There have been instances where men have objected to take lime juice?—I like it.

3535. Do you think that, in your case, scurvy arose through your not taking lime juice?—I do not think that I should have had it as badly as I had if I had taken lime juice. I think, partially, it did arise from that. And there is another thing that I think pro-

bably may have induced scurvy with me, I smoked a great deal at that time. I had not been in the habit of smoking until I went there, and, having nothing else to do, I used to put a pipe in my mouth, and smoke a great deal more than was good for me, not being an habitual smoker. I think the amount of nicotine I swallowed might have acted as a predisposing cause.

3536. Did you observe any similar effects amongst the men of the "Fox"?—No; I cannot say that I have.

3537. In your sledge expedition did not the men like their tobacco?—Yes.

3538. Do you consider lime juice necessary in arctic expeditions?—Most distinctly.

3539. And you, therefore, consider that, had you the responsibility of forming a sledge party, it should be an article of ration?—Distinctly, if it were a journey of any duration.

3540. Have you formed any opinion of the causes of the outbreak of scurvy in the late expedition?—I cannot understand it at all. I do not see why it should have occurred. There was nothing in it, so far as I know, left undone that could have been done; the dietary was as good as it could have been. I can form no sort of opinion of the cause.

3541. In the event of your being supplied with fresh meat and vegetables, would lime juice be necessary?—I think no more so than it would be in England.

3542. Had you a craving for fresh meat?—Yes, distinctly.

3543. And did you eat it raw?—As nearly raw as possible; and not only had we a craving for meat in a nearly raw form, but also for the fat of any meat, even blubber; one had a sort of craving for that.

3544. Was this during your first year or the second?—It is after my return from my long journey, after the second winter in the "Fox," that I was speaking of when I had scurvy.

3545. Had you much opportunity of indulging in this fat; had you much fat with you?—No; not until after our return to the ship.

3546. And what were the fatty matters you used?—What you got out of the preserved meat tins, and so on. I never could manage the blubber of the seal, but I could the fat of preserved meat that one should rather throw on one side at ordinary times; then there was a craving for it.

3547. Did you attach much value to tea in your sledge expeditions?—Very great.

3548. And what is your opinion about rum?—I think it should be taken; but I think that the quantity of one gill is sufficient, a small glass being given in the middle of the day. What I did in my own sledge travelling was to give rather less than half the allowance in the middle of the day, and rather more at bed time, when the men were turning in; but I think one gill is sufficient; that is what we gave. I do not think it is absolutely necessary.

3549. Do you think the men worked better after they had taken their allowance of rum in the middle of the day, or not so well?—I think they worked better. I think they wanted the stimulant, having had rest, you know. We used always to pull up for half an hour, or so, to have luncheon; the men had their biscuit and pork, and so on, and half-a-gill of rum, and I think the rum was a stimulus for them.

3550. It has been given in evidence by several of the witnesses, that tea proved a better ration than rum, and that the men worked better after it; but when rum was substituted for tea, their strength was less, and they did not work so well. Have you heard such an opinion expressed?—I have never heard that opinion expressed, but I have heard men say, who have been travelling with me, that they would rather, if they were compelled to give up one or the other, give up their ration of rum than their ration of tea.

The witness withdrew.

Adjourned to Monday next at 11 o'clock.

MONDAY, 22ND JANUARY, 1877.

PRESENT :

ADMIRAL SIR JAMES HOPE, G.C.B., in the Chair.

ADMIRAL SIR R. COLLINSON, K.C.B.

VICE-ADMIRAL E. A. INGLEFIELD, C.B., F.R.S.

JAMES J. L. DONNET, Esq., M.D., Inspector-General of Hospitals and Fleets, R.N.

THOMAS R. FRASER, Esq., M.D., F.R.S.E.

H. J. VANSITTART NEALE, Esq., Secretary.

FRANCIS YEATES TOMS, Esq., Fleet-Surgeon, R.N., *examined*.

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3551. (*The Chairman*.) I observe that you are a Fleet-Surgeon, with seniority of April 25th, 1872, and that you at present hold the appointment of the Senior Medical Officer in Her Majesty's Dockyard at Devonport; how many years have you been in the service, and of those how many actively employed?—I entered the service January 27th, 1849: have been 28 years in the service: actively employed, 24 yrs. 3 mos. 26 days.

3552. Will you enumerate the arctic expeditions in which you were engaged?—In the expedition of Sir Edward Belcher in 1852, 1853 and 1854. The two ships in which I served were the "North Star" and the "Pioneer," tender to the flagship "Assistance."

3553. Will you enumerate the sledge journeys in which you were engaged?—*One*, when I was ordered to join "Pioneer," the assistant-surgeon of "Pioneer" being promoted. I was then ordered to take charge of "Pioneer" from "North Star." On this journey lime juice was issued.

3554. (*Admiral Sir R. Collinson*.) What were the arrangements on board the "North Star" for warming the lower deck during the winter?—In the first place, daily, every man was cleared from the lower deck, the deck was heated by means of the usual fire, attention paid particularly to the ventilation, officers were sent to see these orders carried out. If any moisture was found on the iron bolts, or any other part of the decks, this said condensation or ice was cleared away. On one occasion the "North Star," during a gale of wind, was carried on shore almost on her beam ends. On this occasion there was a tropical climate on the one side and a polar climate on the other, and hot air ascending consequently. It was then very difficult to keep the ship in one temperature or comfortable. On this occasion, to prevent illness amongst the men, extra allowances of provisions, more particularly in the shape of preserved meats, were issued; lime juice invariably.

3555. Was the method of heating by Sylvester's stove?—Yes; I think so.

3556. Had it an opening on to the lower deck at one end; the foremost end?—I cannot for certain tell you the arrangements of the stove.

3557. You had a portion of the hot air in your cabin?—Yes.

3558. Was there an opening into your cabin?—I believe there were two tubes throughout the ship communicating with the said stove.

3559. Were the tubes open or closed?—Closed, I think.

3560. Therefore it was the heat of the air in the tubes, and not the hot air itself, which warmed the ship?—No; I think the tubes alone.

3561. You spoke of ventilation; will you first of all inform us whether the ship's company lived upon the main or lower deck of the "North Star"?—On one deck, the main deck, in the "North Star." She was an old "Donkey Frigate," as she was called, and the men were on the same deck on which the officers lived.

3562. What was done with the lower deck?—Provisions only were kept there.

3563. Did the men ever sleep on the lower deck?—Never to my knowledge.

3564. Will you describe how the fresh air was admitted on to the main deck, so as to give proper ventila-

tion?—It was difficult, in my opinion, to thoroughly ventilate the ship, as in any other man-of-war; but, under the circumstances, the space being clear of the men for a certain time every day, winter and summer, my professional opinion is, that the ventilation was quite sufficient for the health of the men.

3565. Had you any special uptakes or downtakes?—Yes; I think by means of funnels through the awnings; holes were made over the upper deck, through the awnings, for the reception of those said funnels or cowls at the top. I may observe, that the after hatchway from which the men ascended and descended, was likewise allowed to be open on certain occasions.

3566. Will you describe the covering of the hatchway?—The hatchway was composed of very thick fearnought, I think treble thick, and outside this there was a door which would close of its own accord as the men passed in and out, so as to exclude as much as possible on those occasions cold air.

3567. What was the size of the space at the top of the hatchway?—I should think six feet or about.

3568. Just room for a man to pass?—Higher than that, I should say on or about six feet square.

3569. Had the men room to brush the snow off their clothes before they went down on the lower deck?—Plenty of room on the upper deck.

3570. But not inside the hatchway?—No.

3571. Where did the men leave their clothing?—To the best of my recollection, after they had been well shaken first, they were hung up in a part of the ship set apart for that purpose, but I cannot recollect where. We hung up our things in our cabins.

3572. Had you much condensation on the lower part of the upper deck?—Yes, but it was removed almost as fast, I think, as it was produced, by continually scraping and mopping.

3573. Did it freeze?—Yes, particularly where the iron bolts were.

3574. So that you sometimes had it as moisture dripping, and at other times a white frost?—I do not think it ever dripped. I think that the vigilance kept on that part of the deck was so great that it was never allowed to advance so far. It was removed as soon as formed.

3575. Were you ever awake in your cabin at night by the water dripping upon you from the beams above?—Never.

3576. What was the general condition of the ship's company's health on board the "North Star," during the winter that you passed in her?—Perfect, all hands. Two men, belonging to the Northern division, died, named Harris, A.B., and Barnett, captain of the maintop; the former had always been a *very intemperate man*; this man was ill a *very long time*, and I am almost sure died from the results of disease of liver; *not*, to the best of my recollection *from scurvy*. The other man was a fine fellow, but scurvy was *not* the cause of his death; both might have died on any other station. Supposing these men had scorbutic symptoms, the proportion is very small taking the number of men during the *two winters and three summers* in those regions, with a temperature *very low*.

3577. Had you any symptoms of scurvy whatsoever?—Not one case.

3578. Was there any hard labour gone through by

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your ship's company?—Yes, a good deal, both during the summer and the winter.

3579. Will you describe what that labour was?—In Melville Bay, working night and day, cutting docks for the ship, so as to prevent a nip.

3580. Then there was night work?—Very often.

3581. What steps were taken to give the men refreshment on those occasions?—What is generally termed in the service "splicing the mainbrace," by means of rum mixed with lime juice.

3582. Was an extra meal ever given?—Yes, I think so, oftentimes.

3583. Were the men much exposed to wet on those occasions?—No.

3584. Had you any tracking along the edge of a field?—Occasionally.

3585. Was that very heavy work?—Not particularly.

3586. Was the tracking or the working of the ice-saw the heaviest work for the men?—The ice-saw.

3587. Then in winter what was the severe occupation?—Fetching provisions and coals to and fro from Cape Riley.

3588. When on that duty the men were not absent from the ship for a very long period?—No.

3589. How long?—Possibly six hours.

3590. It did not necessitate sleeping away from the vessel?—I think not.

3591. You mentioned that on the occasion when the ship was driven ashore an increased allowance of provision was issued. Do you know to what extent?—I know that the quality and quantity of the provisions were altered; in lieu of the salt meat fresh meat was given.

3592. What was the amount of lime juice issued daily on board the "North Star"?—To the best of my recollection one ounce daily.

3593. With respect to the "Pioneer," the other vessel on board of which you spent a winter, which vessel had the best accommodation during the winter for the men, the "Pioneer" or the "North Star"?—"North Star."

3594. Had you any difficulty with the ventilation of the lower deck of the "Pioneer"?—The same arrangements were carried out in the "Pioneer" as in the "North Star," but the space, I think, was proportionately less than in the "North Star."

3595. Which vessel, taking it all in all, was the most comfortable for winter quarters?—The "North Star."

3596. What was the condition of your sick list on board the "Pioneer"?—Very small.

3597. In the "Pioneer" your men were detached sledge-travelling?—Yes.

3598. On their return from sledge-travelling, what was their condition?—Perfectly healthy.

3599. Then neither on board the "North Star" nor the "Pioneer" had you any symptoms of scurvy whatsoever?—None whatever.

3600. (*Admiral Inglefield.*) In what condition were the men when you took them on board from the ships that were deserted when I arrived at Beechey Island?—Good health.

3601. Had you any symptoms of scurvy among them?—Not one, to my knowledge.

3602. Did the men on board the ships in which you were engaged always take their lime juice; were they made to drink it on the quarter-deck?—Never on the quarter-deck, but they were seen to drink it. They were told to drink it, and I believe every man took his quantity of lime juice willingly at all times.

3603. Do you consider that lime juice deteriorates by being kept in the arctic regions?—Ours did not.

3604. Were you engaged on any sledge journeys?—One; for the purpose of joining the "Pioneer."

3605. Were you the medical officer of the ship when sledge parties were sent away?—Yes.

3606. Did you give instructions to the officer in charge of the sledge?—I did in the "Pioneer."

3607. Then when you issued those instructions, did you give special cautions with regard to scorbutic symptoms and remedies?—I did.

3608. Were you supplied with beer in the ships to which you belonged?—In the "North Star"; brewed on board.

3609. Then you had no beer put on board in cask?—No; on leaving England, I believe, a certain number of casks of ale were put on board some of the ships, but they were soon consumed. I do not remember any in "North Star."

3610. Did the men freely use tobacco?—Some did.

3611. Have you any opinion as to whether acclimatisation in the arctic regions has any effect upon the men's constitutions; I mean by that whether, if the men had made several arctic voyages, like the whalers' crews do, it would have been an advantage?—During the summer cruises, No.

3612. Do you think if a man has served one or two winters in the arctic regions without any excessive exertion, that his constitution is in some measure inured, and that he will be better able to withstand the rigours of the climate afterwards?—If he has always been in perfect health, certainly.

3613. We have had it given in evidence, that age was an important element as regards the ability of a man to withstand the attacks of scurvy; it has been suggested that in the recent arctic expedition the men were all under 30, and a petty officer who made the suggestion that these men were too young, said that it was his opinion, and he had been, I think, engaged in three arctic expeditions, that men were more likely to be able to withstand the attacks of scurvy when their constitutions were more formed; in other words, that they would be less likely to be attacked if they were between the ages of 30 and 40, than they are from 20 to 30?—I quite agree with him.

3614. Have you any further remarks to make upon that subject, and upon what grounds do you base your opinion?—Yes; I think men of that age, and healthy, are endowed with more determination, have less anxiety; and, in my opinion, the system is better able to undergo privations and hardships.

3615. By that you would wish us to understand that the mind has a good deal to do with this affection of the body?—I do; I think there is less anxiety in men of that age.

3616. Then I understand that you are decidedly of opinion that taking men under the age of 30 is not so suitable for arctic work, as if the men were over 25 or 30?—That is my opinion.

3617. Would you fix any limit?—I should say under 50.

3618. Say between what two ages?—I should say not younger than 31, and not older than 48.

3619. You saw, of course, the whole of the crews that left your ship in Sir Edward Belcher's expedition; you saw also the men that came from the "Investigator," and were taken home in the "Phoenix"?—Yes.

3620. And you were able thus to form a very fair opinion as to the conditions of the men of that age?—Yes.

3621. And, therefore, the suggestion which you now make to the Committee is based upon that experience?—I saw little of the "Investigator's" crew, but from all I did see and hear it was based upon that foundation.

3622. I suppose you were not able to obtain scurvy-grass or sorrel at Beechey Island?—No.

3623. Did you grow mustard and cress?—Yes, in the "North Star."

3624. In any quantity?—No, not to any extent; we had it about once a week.

3625. Have you formed any opinion as to whether men of temperate habits; that is to say, men who had not been in their lives given to excessive drinking, had a better chance to withstand the attacks of scorbutic disease?—I certainly think that the more temperate men are, in moderation, the better, if they have arduous work in those regions.

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3626. Have you ever heard of scurvy being amongst the Esquimaux?—No, I have not.

3627. If you, with all the experience which you now have, were about to accompany a sledge journey, would you think it important or not to carry lime juice?—Most important to carry lime juice.

3628. Has any way occurred to your own mind in which it might be carried, so as to obviate the necessity of heavy packages, such as stone jars, and the necessity of thawing it by means of fuel?—I have read of its being concentrated into the form of a jujube or lozenge; but I have not had any experience.

3629. You have heard of that as a suggestion, but you are not aware of it as an actual fact?—No.

3630. Do you see any difficulty in carrying out such a suggestion?—No, I do not.

3631. Do you think that there would be any great objection amongst the men if the lime juice were mixed with the tea?—I think there would.

3632. That it would make it unpalatable?—I think so.

3633. If it could be made into the shape of a lozenge or a jujube, it might be put into the mouth and sucked as if it were a lozenge?—Yes; I think so; it is a good suggestion, whoever made it.

3634. Have you any idea as to the size into which the actual quantity of lime juice, which amounts in capacity to the size of a bantam's egg, as we have been told in evidence, might be condensed?—I have never worked that out, and I could not say.

3635. Did you get much game at Beechey Island?—Very little; indeed, I may say none. In summer we might shoot a few gulls and dovekies; but they lasted a very short time.

3636. Did you kill many bears?—I believe two; but they were given to the dogs.

3637. What number of dogs had you?—At one time about 18, I think, but they died away.

3638. Do you happen to remember if there is anything recorded on the graves of the three men who belonged to Sir John Franklin's expedition, as to what they died of?—No, there is nothing to say what they died of. I have a copy of their grave-stones in my journal.

3639. You will remember that one man was dug up by me when I was there?—Yes, I was with you.

3640. Do you remember what his symptoms were?—I should say natural death; not from any scorbutic attack.

3641. I think Dr. Sutherland thought that it was from consumption?—No doubt the man had that feel, at all events.

3642. Have you any suggestions that you could make with regard to the present enquiry which may assist the Committee, and which have not been elicited from you by the questions which I have put, the object of the enquiry being to find a cause for the outbreak of scurvy in the recent arctic expedition?—I cannot suggest anything more than I have already said upon the subject. My ideas can be gleaned from my evidence.

3643. (*Dr. Fraser.*) The heating on board both those ships was effected, as I understand, by means of ordinary stoves, and also by a Sylvester stove?—Quite so.

3644. Will you inform the Committee if the Sylvester stove has by its pipes any communication with the outside air?—I do not remember. This I only know, that the ship was heated throughout by means of those tubes communicating with the Sylvester stove.

3645. Then you regard the Sylvester stove simply as a heating apparatus, and not as a ventilating apparatus?—Yes, I do.

3646. What do you consider the great difficulty in the proper ventilation of arctic ships, especially when they are laid up during the winter?—The difficulty of affording openings above. The great point, I think, is to prevent much cold air coming into the lower deck.

3647. That is to say, the external cold is the chief obstacle to the admission of fresh air?—Yes.

3648. Do you think that it would be any advantage to pass the air admitted from the outside through some heating chamber, previously to its distribution in the ship; and by this means could not the renewal of the air be effected more frequently than otherwise?—The men on those occasions are cleared out, and consequently the foul air makes its escape.

3649. For how many hours every day are the men cleared out?—I should say about three hours during the day the ship is cleared entirely of the men on that deck, and, therefore, there is ample space for ventilation to pass in and out; and if condensation has taken place, which very frequently it would, then the moisture is removed at once, I believe, before freezing takes place.

3650. Is not foul air as important to avoid as condensation from moisture?—Certainly.

3651. Do you consider that by freeing the decks for three hours you can avoid foul air during the rest of the twenty-four?—To a certain degree, certainly.

3652. It is an advantage, no doubt; but do you think it is sufficient?—It is not sufficient; but more could not be obtained without doing more damage to the men.

3653. Why?—Because, if the men were exposed to the air too long, without their dinner, they would suffer. They were sent out immediately after breakfast; the more they could continue out during the day, without doing damage to the men, so much the better. They went out in their usual walking dress, not in their usual sledge dress.

3654. Could not some change of air be effected while the men were occupying the main decks?—The air generally passed in various ways into the lower deck, while the men were assembled; but during that time condensation was taking place, and, as I said before, so many times during the day this said condensation was removed by men who were placed for that purpose.

3655. I think you have already told us that the great obstacle to the renewal of the air, while the men were occupying the main decks, is the extreme cold of the air introduced?—Yes.

3656. Then would it not be an advantage, if practicable, to heat this fresh air before its distribution?—But the air is heated by means of this said Sylvester stove always.

3657. I understood you to say that, so far as you were aware, the pipes connected with the Sylvester stove had no connection whatever with the outside air?—I do not recollect, but still the heat thrown off by those tubes would heat the air notwithstanding.

3658. But you do not quite understand my question; I refer to the fresh air admitted being heated, and not to the heating of the air already inside?—I agree with you, that if that could be done it would certainly be of great service to future expeditions.

3659. Both in the way of maintaining a pure atmosphere, and of getting rid of a large proportion of the vapour given off during respiration and otherwise?—Certainly.

3660. Whilst you were connected with the "North Star," I understand you to say that you had no scurvy?—No scurvy at all.

3661. And that your bill of health was a very light one?—A very light one.

3662. Can you tell us generally what was the dietary on board the "North Star"?—Preserved meat, Edwards's potato, cranberries very often, lime juice always, peas, pickled cabbage, and we had a very particular kind of vegetable compressed cabbage, which, when put under the influence of steam, would swell just to half the size of an ordinary cabbage, with a white leaf. I have not seen any of it for the last ten or twelve years, but it was very much appreciated; also carrots and parsnips. Then we got some sauer-kraut in our ship, which the Americans gave us; also some pickled fruits. We had plenty of vegetables; we had salt meat occasionally. I think we

had salt meat once or twice a week; but during the time the ship was on her beam ends, the salt meat was prohibited by the wish of the medical officers, because we were afraid of scurvy then, as she was so long in that position.

3663. How long was she on her beam ends; I fancy about nine or ten days?—The ship was on her beam ends from September 28th, 11 p.m., to the 11th November, = 43 days; men working fearfully hard, at a very low temperature, from zero to -32° , sometimes all night, until December 3rd (outside the ship), when she became upright.

3664. Did you carry any condensed milk?—Yes, we carried desiccated milk, which remains very much like beeswax, and you scrape it just the same as you would beeswax.

3665. Did you find this desiccated milk a valuable article?—Yes, certainly. The milk that I now speak of was as much appreciated and as much liked as the milk in the tins.

3666. You are aware, of course, that the nutritive properties of milk are extremely high?—Yes, I am aware of that.

3667. Had you any reason to believe that this desiccated milk does not contain the nutritive properties of ordinary milk?—It contains a quantity of sugar. I did not know that it was less nutritive.

3668. You had no reason to doubt it?—None.

3669. What is your opinion of the facility with which this desiccated milk might be carried in sledging expeditions?—The only difficulty is in getting the hot water for mixing it, and the shortness of the fuel for these things.

3670. That is a difficulty, is it not, which is common to nearly everything which you carry which requires cooking?—I think so.

3671. It is not a special difficulty belonging to desiccated milk?—No.

3672. Did you carry any eggs with you on board the ship?—No.

3673. I should like to know if this sauer-kraut that you have mentioned was liked by the men?—No, I cannot say it was; we had not much of it; it was merely a present: it was not supplied by Government.

3674. It was chiefly used as a medicine, was it?—I did not know this. The men were asked to take it if they liked it, and if they wished it they could have it.

3675. It was regarded by them as a medicine, was it?—Yes.

3676. What was the number of your crew on board the "North Star"?—I should think about 80.

3677. How long were these men in the arctic seas?—Two winters and three summers.

3678. And during all that time, do I understand you to say, on the dietary which you have just mentioned, there was no scurvy?—Not one case.

3679. Had you lime juice?—Yes.

3680. Was it very carefully given?—Very carefully given. The men could be trusted to take it, and they did take it.

3681. You had no extended sledge expeditions in connection with the "North Star"?—Yes, we had.

3682. Can you tell us over what period they extended?—I think the second master was away three or four weeks: I will not be certain as to the full length of time, but I think it was over four weeks, but Staff-Captain Pullen has since informed me (he was master of the "North Star") that the second master was victualled for sixty days.

3683. Were dog-sledges, or man-sledges, used?—Man-sledges. The dogs did not do anything at all in those expeditions.

3684. Did the sledge parties carry lime juice?—Yes.

3685. Do you remember about what temperature they were subjected to in those parties?—It varied from -30° to -40° .

3686. Did you hear of any difficulty in administering this lime juice while sledging?—From all I could glean on their return, I think some took it, and some

did not. In the "Pioneer," I am almost sure, they took it.

3687. It was carried in the sledge parties of the "North Star," and, to your knowledge, it was used by, at any rate, some of the men?—Yes, to the best of my knowledge, I believe they did use it.

3688. Therefore there was no insurmountable difficulty to the issue of a lime juice ration when sledging?—No. The orders were obeyed, and I believe there was no difficulty.

3689. In your opinion, was the quality of this lime juice injured by its being carried in the sledges and exposed to the temperature which was then suffered from?—In my opinion, not in the least.

3690. Was the crew of the "North Star" liberally supplied with game or fresh meat?—With preserved meat; but no game, and no fresh meat at all.

3691. Did you succeed in obtaining supplies of fish?—Never.

3692. Had you any blubber?—Never.

3693. Can you describe to the Committee what was the usual dietary of the sledge parties?—Pemmican chiefly, biscuit, bacon, potato, rum, chocolate, sugar, tea, tobacco, salt, pepper, and that sort of thing; and I believe we had a quantity of onion powder likewise.

3694. I will show you the diet list of the recent arctic expedition (*handing the same to the witness*); was your diet list for the sledge parties, so far as you can remember, similar to that, and, if not, in what respects did it differ?—I see one important article not here, and that is lime juice. I think that is the only thing in which there was any difference; also milk, not mentioned, which we had.

3695. You would say it was the same in other respects?—I think so.

3696. Had you more sledging while you were connected with the "Pioneer"?—Yes, more sledging was carried out on the "Pioneer."

3697. Were they long expeditions?—Much longer.

3698. Had you any scurvy in connection with the ship, or with the sledging expeditions?—None whatever.

3699. What was the complement of the "Pioneer"?—Between 20 and 30.

3700. And how long were you in the arctic seas? Two winters and three summers.

3701. Was the diet the same as you have described for the "North Star"?—Much the same.

3702. Was the sledge party diet the same as that which we have already considered?—Yes, with the exception of lime juice.

3703. Can you give us an idea of the length of absence of the most extended sledge parties from the "Pioneer"?—I think Admiral Richards went the furthest. I think he was away, to the best of my recollection, between six and eight weeks.

3704. In very cold weather?—I think in very cold weather.

3705. Can you give us an idea of the temperature?—I should say, at least -40° .

3706. In what months would this be?—I should say, about the end of March and April or May.

3707. Did you hear whether any difficulty was experienced in serving the lime juice during any of those sledging expeditions?—I believe they took it and drank it.

3708. There was no insurmountable difficulty?—Not to the best of my knowledge.

3709. Have you any certain knowledge, whether they took it or not?—In the "Pioneer," I have certain knowledge that they did take it.

3710. Was the health-bill of the "Pioneer" as satisfactory as that of the "North Star"?—Equally.

3711. Did you suffer from frost-bite at all?—Slightly, from very slight frost-bite.

3712. Had you much game or fresh meat while you were connected with the "Pioneer"?—No fresh meat or game.

3713. Had you any fish?—No.

3714. Then your meat supply consisted, entirely, of what you carried with you?—Quite so.

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3715. Can you tell us, generally, from what sources you obtained the drinking water in connection with both ships?—From the snow melted, entirely.

3716. And were you satisfied with the quality of that water?—Yes, perfectly.

3717. Will you inform us what evil effects you believe to result from the eating of snow to quench thirst?—None that I saw. I have eaten it myself, in bucketsful, I was going to say, but a good deal, at any rate, when I have been out on expeditions, and when I have been in a fog, and obliged to rest, not sleep (to sleep would be to die with such a low temperature) in the snow all night.

3718. Have you had any opportunity of observing if, while the men were heated, after exertion, the eating of snow was injurious or not?—I have had observation personally, having had to rest in a snow trench, having been befogged, and not able to find the ship, and I believe the snow saved my life.

3719. It was not melted snow, was it?—Snow on the surface of the ice, and melted in my mouth.

3720. Did you take much?—I took sufficient to quench my thirst, and felt refreshed after it.

3721. Is it your opinion that the eating of ice is also equally safe?—No, I do not think so.

3722. Why not?—The sudden abstraction of heat is greater in that way than by eating snow, consequently you are more liable to injure your mucous membranes.

3723. Have you arrived at any opinion as to the reason why you so fortunately, in the "North Star" and "Pioneer", escaped scurvy, and if so, what is your opinion?—My opinion is, that the men were very carefully looked after, the decks were properly looked after, and the diet was properly looked after, especially the taking of lime juice, both on board and on the sledge, as much as it could possibly be done.

3724. I suppose that one of the objections to carrying lime juice is the addition which is thereby caused to the weight of the equipment?—I think so.

3725. Is it your opinion that if the 80 or 90 per cent. of the probably useless water contained in lime juice were previously abstracted, this objection would to some extent be obviated?—I do think so.

3726. You have told us that you thought it very important that men engaged in such work as we are now talking about should be of mature years; can you tell us what were the ages of the men in the "Pioneer" and the "North Star," or rather between what ages did they range?—I really think they were over 30.

3727. Without exception?—No, the majority, I think, were over 30, but I would not be certain.

3728. Can you supply us with that information?—I think the Journals at the Admiralty would. Of those that were on the sick list with phlegmon and other diseases incident on board ship, such as colds, the ages were given.

3729. (*Dr. Donnet.*) As a medical officer attached to an arctic expedition, and having had experience for two winters, besides the experience you had in the "North Star," have you formed any opinion about the outbreak of scurvy in the late expedition?—It is impossible for me to say.

3730. Do you think that cold, and especially the cold that these parties endured in their sledge expeditions, had any effect in the production of scurvy?—I should think not. Our mean temperature during the two winters, I think, was as great as the cold of the late expedition.

3731. Combined with the cold, there was much fatigue. In your opinion, had fatigue any share in producing this disease?—Not in well-nourished and healthy bodies. Our men, and officers too, were very much fatigued during their two winters of arctic travelling.

3732. Are you aware that they were subjected to an absence of the sun for 142 days, and do you think that the absence of the beneficial influence of light had anything to do towards this?—As I said before, not in well-nourished and healthy men.

3733. It is difficult to have a pure ventilation in ships fitted for arctic expeditions; what opinion have you formed about the action of this impurity, combined with the moisture to which they were subjected, in reference to the production of this disease?—Such would not be, in my opinion, sufficient to have caused scurvy in healthy and well-nourished men; but even to healthy and well-nourished men such moisture and impurity of air would help to produce debility and scurvy.

3734. Can you not think of any cause that was in action towards the outbreak of scurvy in this recent expedition?—I cannot.

3735. (*The Chairman.*) You have had no opportunity of reading the reports of any of the officers of their sledge journeys?—Except through the medium of the public press.

3736. Or Sir George Nares's account in his official report?—Except through the press.

3737. If you are supplied with the official reports of the expedition, will you have the kindness to furnish the Committee with your opinion as to the cause of the outbreak?—Yes, I will do so.

3738. (*Dr. Donnet.*) Was the dietary of Sir Edward Belcher's expedition similar to the scale of victualling for the "Alert" and "Discovery" which I now hand you (*handing the same to the witness*)?—It is pretty much the same. I cannot at present see much difference.

3739. Can you tell me whether the men of the "Pioneer" showed any preference for any article of the food supplied?—For fat bacon or preserved pork, they had a craving for it.

3740. In your own person, had you any preference for one article over others?—Yes, for fat bacon; and the men had the same preference generally.

3741. Was there any objection to preserved meats?—None; the men liked them very much.

3742. You mentioned cranberries as one of the vegetables supplied to you; were those brought from England in a preserved state?—I think so; in the "North Star." I know that that was so.

3743. Were no antiscorbutics, in the shape of sorrel or cranberries, found in the vicinity of Cape Riley, or on Beechey Island?—None.

3744. I believe you mentioned condensed milk; had you any of Moore's concentrated milk with you?—I do not know; what they call desiccated milk we had.

3745. Do you attach much value to rum as an article of diet on board arctic ships?—Under certain circumstances, yes; in cases of great fatigue particularly, or to make a special "spurt."

3746. At what time of the day would you administer this allowance of spirits?—On turning in.

3747. Would you give it at any time during which the men were travelling?—No, except on turning in, or to make a special spurt.

3748. And for what reason would you not give it in the middle of the day?—From my knowledge of arctic sledging, I believe rum, or any other spirit, tends to debility.

3749. What is your opinion about tea in sledging parties?—If it could be obtained, it is most refreshing.

3750. You attach much importance to fat bacon; have you any suggestion to offer towards adding butter to the list of arctic diet?—Yes, that would be an improvement.

3751. I believe you consider lime juice as an essential article in sledging parties?—I do.

3752. Do you think that its absence would produce scurvy?—Very probably.

3753. Do you not think it an essential article of diet in sledge parties?—I do.

3754. What quantity of lime juice was taken in the sledge parties of which you have experience?—I do not remember the exact amount, but I think it was under one ounce.

3755. You never formed one of a sledge party; but did you hear the opinions of the men who had been in those parties, and whether they got fuel for melting

the lime juice?—I believe, if asked for, it was allowed by the commanding officer of the sledge party.

3756. Do you know what the opinion of the late Sherard Osborn was upon the subject of lime juice in arctic travelling?—I think favourable. In conversation, at different times, I have always understood him to approve of lime juice at all times.

3757. Do you know what time the men took in making their tea on those sledge parties?—I should think, from the conversation that I had on the return of the sledge parties, that it would take twenty minutes.

3758. Do you think that this time was in any wise injurious in checking the perspiration of the men after the hard work that they had had?—No, I do not.

3759. (*The Chairman.*) Assuming that a daily allowance of lime juice could have been administered to the sledge parties, are you of opinion that the outbreak of scurvy would have been delayed?—I think by giving lime juice, it is very probable that scurvy would not have taken place.

3760. After perusing the papers which have been supplied to you, will you be good enough to add your opinion, whether scurvy might or would have been averted altogether, and, in such a case, what daily

allowance you would recommend?—I have the honour to state, that after carefully perusing the papers, I believe scurvy would have been averted in *nearly all* the cases. I would give three-quarters of an ounce daily, and one ounce to sledge parties. Of course, some cases were worse than others, debility being greater, latent from some cause, no doubt, during the winter; some debilitating cause; hence the difficulty of averting or curing the disease *in every case* when sledging. Rest, and lime juice would do, and have done, wonders. After perusing the papers of the late expedition, and knowing *what work* Captains Richards, Osborn, and men, did, and the amount of exposure experienced *for two winters*, I am compelled to believe that our exemption from scurvy was greatly due to the careful manner in which lime juice was issued to every one, both on board and to those sledging. Cold, while travelling, was as great as in the late expedition. Anxiety, *perhaps*, equally as great. It seems odd, that the late expedition should have been attacked with this debilitating disease (blood disease), scurvy, so very soon after leaving the ship; going greatly to prove what I have already said, that there must have been some weakening cause previous to their departure.

The witness withdrew.

CAPTAIN ALLEN YOUNG, *examined.*

3761. (*The Chairman.*) From the return which you have been good enough to furnish to the Committee, I observe that you have made four sledge journeys from the "Fox," in latitude about 72° north, all after two winters passed in the ice. I further observe that on the first of these journeys you left your ship on the 17th of February, 1859, returning to her on the 3rd March, after an absence of fifteen days, days of leaving and returning included, and having travelled 173 miles, at an average daily rate of seven miles, in a temperature varying from -36° to -45°, averaging -41°, with constant strong winds, accompanied by a four-man sledge, one dog-driver, and dog-sledge. On the second of these journeys you left your ship on the 18th of March, returning to her on the 30th of the same month, after eleven days' absence, having travelled 182 miles, at an average daily rate of 16½ miles, in a temperature varying from -10° to -20°, averaging -15°, with moderate winds, accompanied by two sledges, seventeen dogs, and three men. On the third journey you left your ship on the 7th of April, returning to her on the 7th of June, after an absence of 62 days, having travelled 720 miles at an average daily rate of 11½ miles, in a temperature varying from +30° to -18°, averaging +8°, with strong winds during April, and light winds subsequently, accompanied by two sledges, five men, and six dogs. That on the fourth journey you left your ship on the 10th of June, returning to her on the 30th, after an absence of 21 days, having travelled 240 miles, at an average daily rate of 11 miles, in a temperature varying from +41° to +30° averaging +34°, with light winds, accompanied by a four-man sledge and dog-sledge and driver, making the total distance travelled 1,315 miles?—Yes.

3762. What was the general character of the ice over which your journeys were performed?—On the first journey the ice was smooth, in crossing Franklin Straits, until arriving on the coast of the Prince of Wales' Land. Then we found heavy hummocks lying along the shore, which compelled us to make great deviations, and to travel principally inside the tide crack, where we found the ice very fair for travelling. On the whole, on that journey I should consider the travelling very fair. The only difficulties that we had to encounter were from the extremely low temperatures, accompanied by wind. On the second journey I was ordered by Sir Leopold McClintock to Fury Beach, to try and obtain some provisions which had been left by Sir Edward Parry. I left the

ship with one seaman and two Esquimaux, and a dog-sledge (there were two sledges), and, depending on Fury Beach for provisions, we took no outward load, which enabled us to run nearly the whole of the way, the ice being very good. In returning we had about 1,100 lbs. on the two sledges, and, in consequence of one breaking, the whole load was thrown on one sledge, which made the travelling back more tedious. On the third journey, I left the ship on April the 7th, with one four-man sledge, one dog-driver, Esquimaux, and one sledge drawn by six dogs. We went across Franklin Straits to Prince of Wales' Land, travelling over the same route as on the first journey, for the first 70 miles, my instructions being to proceed to Collinson's farthest, if the east coast of Prince of Wales' Land was found to be continuous; but should I find a strait running to the north-west, I was to continue round Prince of Wales' Land, and to connect the exploration with Sherard Osborn's farthest. The travelling was very fair until we arrived at a point which proved to be the southern termination of Prince of Wales' Land. There we discovered that a wide strait separated that land from Gates Head Island and Victoria Land. Here we met with ice quite of a different character, evidently the polar pack forced from the north-west through this channel. Finding the travelling becoming very difficult in consequence of the heavy character of the ice, and also that I should now have to proceed as far as Sherard Osborn's farthest point, I sent back on the 29th of April all my men, excepting one, and continued on to 72°53' north on Prince of Wales' Land, with one man and four dogs, and, having no tent, we were obliged to sleep in holes in the snow, the tent having been sent back with the men. Having ascertained beyond doubt that we had overlapped Sherard Osborn's point, I returned to latitude about 72°40', and from there struck off to see how far I could proceed across this new channel, now named McClintock Channel, and to ascertain as to existence of high land reported to have been seen by Sherard Osborn. We there found the ice all broken up into great angular blocks, with soft snow intervening, and after proceeding about 30 miles, I was obliged to return to the land, in consequence of our sledge and ourselves frequently falling in, and being completely buried in the snow. After returning to the land, I found that a bear had destroyed our fuel by making a hole in the spirit can in the depôt that we had left on the land, and, in consequence, we had to eat cold pemmican

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afterwards. We had sufficient fuel from some bear fat (I had killed a bear previously) to melt water and make some tea. We lived after that on cold pemmican, frozen. We then proceeded homeward towards the ship, having completed my orders; my orders received did not include crossing the straits, which were till then unknown, they were merely to reach Sherard Osborn's farthest. We arrived at the ship on June the 7th, very much exhausted, having had latterly to sleep on the sledge, and we had not strength enough for about the last 20 days to build snow houses. I come now to the fourth journey. As neither Sir Leopold M'Clintock nor Lieutenant Hobson had already arrived at the ship, and not knowing whether they had discovered any of the Franklin records, I considered it necessary to complete the whole of the unexplored area, so that nothing should be left undone; consequently, I started on June the 10th, to explore Peel Straits on both sides to Browne's farthest on the west, and Ross's farthest on the east side, taking with me my crew, who had in the meantime returned to the ship; I mean the same crew that had been sent back during the first journey, and were now sufficiently recruited in strength. Nothing particular occurred on this journey beyond the fact of the floe being latterly so flooded with water that we were generally wading up to our knees. We arrived back in a very exhausted state, but had completed the objects of our journey; we had reached both points.

3763. What was the general depth and character of the snow on these journeys?—On the land, I should think 4 feet deep.

3764. Was it generally hard, or did you sink in it?—I am speaking of it on the low level limestone coast of the Prince of Wales' Land; on the ridges there was no snow. The floes in many cases were quite bare of snow, and with not sufficient to build a snow house.

3765. And between the hummocks on the ice, what was the character of the snow?—Between the hummocks, the snow was quite loose.

3766. Have you read the reports of the sledge journeys performed by the late expedition, and how do they compare in point of difficulty with those performed by you: first, as regards the land journeys, and secondly, as to that over the ice to the north?—I have merely glanced at the sledge journals. My opinion is that, with the exception of my attempt in M'Clintock Channel, we met with no obstacle that can in the least compare with those which Captain Nares' sledge parties appear to have encountered. In the case of the M'Clintock Channel, the ice appears to have been somewhat of the same character.

3767. In your sledge journeys, were any of your men affected by scurvy or by symptoms which you would now be disposed to consider scorbutic?—None of my men were treated for scurvy, that I am aware of, on their return from any of the journeys.

3768. With regard to your third journey, when you returned with the man who accompanied you very debilitated, would you now be disposed to consider that debility a scorbutic symptom?—I attribute it entirely to sheer exhaustion, having marched some days as many as 30 miles with but little food.

3769. To what do you attribute your immunity from scurvy on your journeys?—I can only attribute it to the great care that was taken of us by Sir Leopold M'Clintock; I mean the discipline of the ship, the keeping the ship dry, and constant exercise. With the exception of one bear, which we killed on the third journey, we got no game.

3770. Did you carry lime juice in your journeys?—No.

3771. What size of vessel and number of crew do you consider best adapted for arctic service?—It depends upon the object and the distance you expect to have to travel by sledges, and the force required. To reach the pole, I should certainly think it would require a crew of sixty men.

3772. Of course with a vessel of corresponding size?—Yes.

3773. (*Admiral Sir R. Collinson.*) The object of your first expedition in the spring was to explore the route across Peel Straits, and to reach Prince of Wales' Land?—The first object was to carry out a dépôt for the long journey, and I was instructed to place it if possible between 70 and 80 miles from the ship.

3774. What were the weights which you carried on that occasion?—About 1,600 lbs.

3775. In going over to the Prince of Wales' Land, had you ever to unload your sledge; was the ice so rough that you were obliged to make two trips?—No, I do not remember ever having to do so.

3776. You never had occasion to unload the sledge?—No.

3777. On the third trip, what was the date of your arrival at Cape Swinburne?—About April the 28th; it was there where I decided to send the men back.

3778. And from that date until your return on board, on June the 7th, you slept in snow houses or in the tent?—We had no tent; we were obliged to send the tent back with the men. We frequently dug a kind of grave, just sufficient to hold two; and we had a brown holland sheet, a part of the tent gear, supplied for keeping the snow-rime from falling on the tent-rope; that was the only shelter we had, a brown holland sheet.

3779. Had you anything between you and the snow when you slept?—Nothing except our bags. We each had our sleeping bag with us.

3780. But you had nothing between the sleeping bag and the snow?—Nothing.

3781. When you went off to try to cross M'Clintock's Strait, you stated that the sledging was very difficult indeed; did you take the dogs with you?—I took the dogs.

3782. And how did they manage to drag with the hummocks?—We found it almost impossible to make any progress at all with them. On some occasions the dogs were hung up on one side of the hummock and the sledge on the other, and they floundered in the soft snow.

3783. Was the snow so soft between the hummocks that the dogs floundered in it?—Yes.

3784. What kind of sledge had you; was it a runner or a flat sledge?—A runner sledge, built purposely light for dogs.

3785. Was the snow compact enough for you to have made a snow hut, or was it so loose that you could not have done so?—We could not have built a snow hut without deviating to some small level floe, where we should have found the snow hard.

3786. Did you come across any water at all during that part of your journey?—No water, nor any signs of water.

3787. On returning to the shore you found your fuel had been partly destroyed by a bear, and you could not cook your pemmican; had you sufficient to make any tea?—The fuel destroyed was spirits. We had some tallow remaining, and also a portion of the fat of a bear which I had shot, which enabled us to cook the tea and melt water, and was sufficient to last us during the remainder of the homeward journey.

3788. But you had to eat your pemmican raw?—Yes.

3789. Had you sufficient fuel to cook potatoes?—We had sufficient fuel to steep potatoes, but I cannot remember that we had potatoes.

3790. Did you not take Edwards's preserved potatoes with you?—We had them on the sledge, but I cannot say whether we sent them back or not. I think we did.

3791. Consequently your diet from the time the sledge left you, was pemmican and biscuit?—Pemmican, biscuit, tea and tobacco.

3792. And that for forty days?—For forty-one days.

3793. And yet you do not think that scorbutic affections occurred, either to you or to the man Hobday?—I cannot say; it might be a scorbutic attack that we had.

3794. But on the third day after your return on

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board you set off again?—I set off again, against the remonstrances of the doctor, who, however, said nothing to me about scurvy.

3795. On this occasion you had tent accommodation?—Yes; tent accommodation.

3796. I believe that you lost two men on board the "Fox," by death?—We lost three altogether. The engineer died of apoplexy.

3797. Do you know whether any of these men were attacked by scurvy?—The ship's steward died of scurvy, according to the surgeon's report; but he had refused to eat anything but salt meat, as I understood, and used to get at the spirits; that, I understood was the surgeon's report; that he had had charge of the spirits, in which there was a deficiency.

3798. Then, so far as you are capable of judging, hard work or exposure in sledge parties had nothing to do with the production of scurvy in this man's case?—Certainly not; he never went a journey; he never left the ship, that I am aware of.

3799. Do you know whether he was in the habit of taking lime juice?—I cannot answer as to that.

3800. (*Admiral Inglefield.*) Did the men on board the expeditions in which you have been engaged regularly take their lime juice, summer and winter?—I believe, in the "Fox" the lime juice was issued.

3801. They were not seen to drink it?—They were not seen to drink it, as far as I know, and it was reduced in quantity, I believe, to an ounce instead of an ounce and a-quarter.

3802. The quality and quantity of the provisions that you had on board the "Fox," were based on those that were supplied to Government arctic expeditions, and of the same quality, I presume?—I believe so.

3803. Was there anything in the scale of diet which was peculiar to your expedition?—The only thing that I can remember is, that Sir Leopold M'Clintock always saved the lime juice as much as possible, and did not issue it when there were any fresh provisions, or when he served out some beer, sugar-beer, which was made on board.

3804. In your opinion, is tea or rum the most agreeable to the men, and which is the most beneficial for making sledge journeys?—I should find it very difficult to answer that question.

3805. Would you say a proportion of each?—I should certainly suggest a portion of each.

3806. But do you give to either the preference whilst actually travelling. The reason I ask is, because we have had it in evidence that the men seemed to travel much better by taking tea for their lunch, or their midday meal, and having the rum only when they got into their bags at night to make them sleep and to warm them; and that a decided preference has been given to tea for travelling upon?—I think, if it was a question of which should be excluded, it should be the rum; but, in midday travelling, it would have been impossible to us to make tea for lunch, because we could not take sufficient fuel.

3807. What did you carry as fuel, then, in those days?—We had tallow and concentrated spirits, and, I think, stearine.

3808. Did you find sorrel and scurvy-grass?—None.

3809. Have you formed any opinion as to what is the proper age, or the best age, for men on arctic service, giving us two limits, the maximum and the minimum?—Not being a medical authority, my own opinion would be from about 30 to 35.

3810. Did you find that the temperance men, or men who were of temperate habits, were less likely to be afflicted with scorbutic symptoms than those who were inclined to indulge?—I have had no experience.

3811. I think you mentioned that one man died of scurvy who had been known to be intemperate?—He was supposed to be intemperate, but he was not a sledge traveller.

3812. How was your ship housed over during the drift in the ice?—We were housed over in the usual manner adopted in Her Majesty's ships.

3813. Did you suffer much from condensation on the

lower deck?—Sir Leopold M'Clintock took incessant pains, in fact it was his hobby, to clear away everything like the appearance of condensation or dampness.

3814. Can you give the Committee any idea which you may have formed as to what are the exciting causes which produce scurvy?—I can only speak from my experience in the merchant service, in which I have found cases of debility where men have been sleeping in very close quarters, and it has been so accounted for by the surgeon when he was not able to account for it in any other way.

3815. Have you often seen scurvy on board ship?—Not of late years.

3816. And when you did, was it in a tropical climate?—Principally in a tropical climate.

3817. Had the men lime juice?—Always lime juice.

3818. But I presume the provisions were principally salt meat?—Salt meat.

3819. Then you consider that a want of a sufficient number of cubic feet in the sleeping apartment in the case you allude to had something to do with the outbreak of scurvy?—I am speaking generally of my experience in the merchant service, commanding merchant ships. We have had cases sometimes of a man who has been debilitated, and the surgeon's report has been that, instead of the man being ordered off duty and kept in his hammock, he ought to be kept on deck and have more fresh air, for the scorbutic tendency.

3820. It clearly points to this, that the number of cubic feet a man has to breathe in, tends to improve or debilitate the system according to quantity?—That would be my impression.

3821. Have you any suggestion which you can make with reference to this present enquiry on which no question has been already put?—I have no suggestions.

3822. (*Dr. Fraser.*) Some years ago you had seen scurvy in the merchant service, you say?—I am speaking of very early days, in East Indiamen. I do not say they were cases of scurvy. I meant that we had cases which the officers supposed might be cases of men evading their duty, but the surgeon explained that the men were not shirking their duty, but were only debilitated.

3823. Can you tell us, in a general way, how long ago that would be?—25 years ago.

3824. Do you know if at that time it was very frequently the case that the lime juice served in the merchant service was impure and adulterated?—I think I have heard so, but I have never heard it proved.

3825. You know, do you not, that a good many years ago it was proved frequently that lime juice was adulterated, and that in consequence of this steps were taken to insure, as far as possible, an unadulterated lime juice being supplied to the merchant service?—I believe that there is a Board of Trade regulation with that object.

3826. Did you judge from information received from medical officers on board the merchant ships in which you saw scurvy, that that scurvy was the result of sleeping in close quarters; or, did you judge that the medical gentlemen considered it advisable in the treatment of cases of scurvy, after they had occurred, to insure as much pure air as possible?—I do not say that I ever heard of an actual case of scurvy. I only say that I have heard that cases of debility had been attributed to that cause.

3827. Means were taken, however, to improve the air breathed by these men, only after the debility had occurred, I imagine, that is to say, in the course of their treatment; is that so?—It has always been my experience with surgeons on board ship, that they have made every attempt to improve the condition of the lower deck with regard to ventilation. I merely mention that, in cases where a man has been reported as evading his duty, we had been told that instead of being excused it would be better to keep him more in the fresh air.

3828. Do I understand that your longest sledge journey was the third one?—It was the third one.

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3829. You started with two sledges, I think?—Two sledges.

3830. And in a short time you sent back one of these sledges?—I sent back one.

3831. And then you continued your journey with one dog-sledge and one man?—Yes.

3832. So that the greatest part of the journey was done by yourself and one man alone?—Yes.

3833. And the hardships that were encountered on this third journey were chiefly encountered by yourself and your companion?—Yes, they were.

3834. Did your companion also suffer from debility?—Yes, he did; he frequently fainted.

3835. Can you recollect if you at that time suffered also from pains similar to those of rheumatism?—No, I had no pains.

3836. Had you any discolouration of the skin?—I never undressed; I never examined myself, to my knowledge, from March until the beginning of July.

3837. So that you might have had discolouration without its being observed?—I might have had. I was never examined.

3838. And might that have been the case with your companion also?—I believe that to be the case.

3839. And you returned to the ship, I think, on the 7th of June?—Yes.

3840. You went under medical care then?—I reported myself to the surgeon as very exhausted, and my brain very weak.

3841. Can you at all recollect how he treated you?—As far as I remember, he told me to eat and drink as much as I could.

3842. Was a supply of vegetables included in your treatment on your return?—I drew no extra rations at all.

3843. You had the ordinary ship's rations?—Yes.

3844. And these I think include vegetables?—They included preserved vegetables.

3845. Was the stock of lime juice somewhat limited by the 7th of June, do you remember, on board the ship?—I cannot remember; I did not take lime juice as a rule.

3846. You, yourself, never took lime juice?—Now, I seldom take it. I may now and then take it, but, as far as I remember, I scarcely ever took up my lime juice.

3847. Can you remember whether during the three days you stayed on board ship, subsequent to your return on the 7th June, you took any lime juice?—My impression is that I did not.

3848. You did not recover in these three days?—I did not recover. I could not recover the tone of the stomach; that was my principal symptom. I could not retain my food; I would throw it up.

3849. And you left under strong protest, I think, from the doctor, a written protest in fact?—I left under a written protest from the doctor.

3850. Do you recollect the purport of that protest, or can you produce it?—I cannot remember it at all beyond the fact.

3851. Did your companion start on the expedition on the 10th of June along with you?—He went with me on the 10th, I think, as far as I remember. I do not quite remember whether a man was substituted for him or not. My impression is that he must have gone with me, because there was no one else on board the ship.

3852. Now, generally speaking, I think you have already told us that the work done in your four sledge expeditions was considerably if not very much less than that done in the extended sledge journeys of the last arctic expedition?—I consider that we did not meet with such severe labour or obstacles as they appear to have met with, due to the character of the ice.

3853. When the fourth sledge party returned, what was their general condition?—I have here Sir Leopold M'Clintock's book, and I see that I myself travelled the last two days on a sledge.

3854. Why?—I was done up. When I say "travelled," I mean, principally; I would get off and on and walk sometimes. The crew were all in good health, but tired, with the exception of Harvey, the captain of the sledge. On the fourth journey I was very much exhausted, and Harvey was very much exhausted.

3855. What was the matter with Harvey?—It says in the book that his malady was scurvy.

3856. Did you recognise it to be scurvy at that time?—On referring to my travelling journal this morning, I found that Harvey was complaining of rheumatic pains, but which I attributed to wading in the cold water.

3857. You do not know if he had any discolouration of skin, do you?—I do not know; he was a black man.

3858. You do not know whether he had sponginess of the gums, do you?—No, I believe he had not. I saw no bleeding of the gums.

3859. You have been asked respecting the illness of the ship's steward; is that the man Thomas Blackwell?—Thomas Blackwell.

3860. Do you remember if it is the case, that, for some months previously to his illness, the ship's spirits had been removed from his control?—I believe it was the case.

3861. You know, perhaps also, that he lived nearly the whole winter upon salt pork and disliked preserved potato, do you?—I believe the surgeon reported such to have been the case.

3862. (*Dr. Donnet.*) In the opinion which you have afforded of the men best adapted for arctic service you mention age, and you limit it to between 30 and 35; have you any opinion about the height, weight, and antecedent experience of men in northern regions?—I have no opinion whatever.

3863. Do you think black men as well adapted as white for arctic service?—I have only the experience of one coloured man, and he did his duty well, but on one occasion he complained bitterly of the intense cold, the temperature being 40° below zero, and a strong wind, and he said that he could proceed no further; that was the only occasion on which he ever hesitated for a moment.

3864. Did you find any difference between the lime juice supplied to the "Fox" and that supplied to the "Pandora," either in taste, appearance, or otherwise?—No; I have no reason to suppose there was any difference. I consider they were both of the best quality.

3865. In your experience, which I believe to be great, in both hot and cold climates, have you found it necessary to give sailors lime juice?—We are compelled to do so by Act of Parliament.

3866. Are the regulations of the Board of Trade, with regard to lime juice, adhered to generally in the mercantile marine?—Certainly, as there is a penalty attending the neglect.

3867. It has been stated by a merchant captain, that lime juice has to his knowledge been given only when in the tropics, and afterwards the issuing ceased, and that he never met with scurvy among the crews; is this practice observed by any captain in the merchant service, to your knowledge?—I believe the practice is to issue the lime juice, but that constantly the men do not drink it. If it is issued separately from the sugar the men will sometimes throw the lime juice overboard, and keep the sugar, unless in ships where they are made to drink it in the presence of an officer.

3868. Have you sufficient control over the men in the mercantile marine to oblige them to drink their lime juice under the superintendence of an officer or a quartermaster?—I believe in all well-regulated ships a lawful command such as that would be enforced, if considered necessary.

3869. Do you think that the many cases of scurvy which occur abroad in the mercantile marine, are due to the neglect of taking their lime juice?—I cannot say.

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3870. I would like to have your opinion upon the value of vegetables in long sea voyages?—My experience of long sea voyages is, that the crew have never had vegetables, other than in the shape of pickles.

3871. Were these pickles considered as antiscorbutics?—They were considered as a luxury.

3872. Were you ever so circumstanced as to have no lime juice or antiscorbutics in the various voyages which you have made?—No; I never remember a case.

3873. Have you ever heard of gunpowder having been given as an antiscorbutic, in the absence of lime juice and vegetables?—Never.

3874. On your visit to the *dépôt* left behind by the "Fury" in 1825, did you find any remains of provisions?—Yes.

3875. What were they, and in what state did you find them?—The provisions found were principally sugar, preserved carrots in gravy, a few preserved soups, and flour.

3876. Were they in good condition?—Yes, in good condition.

3877. Was no lime juice found amongst those pro-

visions?—No lime juice; I did not seek for any; my instructions were to bring back sugar.

3878. Do you attach much value to tea as an article of diet in arctic expeditions?—I do.

3879. What value do you attach to spirits?—Secondary to tea.

3880. Can men do without spirits in the arctic regions; do you think it necessary that they should have spirits, or that they would suffer much privation if they had no spirits?—I think in the condition in which our seamen live on board the ships, it is a necessity, and it would not do to stop their spirits because of their going on a sledge journey.

3881. (*The Chairman.*)—We have it in evidence, that when the sledge parties camped at night the ration of spirits was found absolutely necessary to enable the men to shift their clothes and make the necessary preparations for the night; what is your opinion about that?—That is not the result of my experience. We found frequently that the men had to get into their bags as quickly as possible. The cook made the tea and pemmican, and after they had had their tea and pemmican we used to give them their grog, and then allow them to smoke.

The witness withdrew.

ROBERT CHARLES SCOTT, Esq., Fleet-Surgeon, R.N., examined.

3882. (*The Chairman.*) From the return which you have been good enough to furnish the Committee, I observe that you have made two sledge journeys from the "Intrepid," in latitude 75° north. I further observe that, on the first of these journeys you left your ship on September the 14th, 1852, returning on the 2nd of October, after an absence of 19 days, having travelled 111 miles, at an average daily rate of about 6 miles, in a temperature varying from +28° to -2°, averaging +12°, with strong winds, accompanied by two carts, with six and seven men respectively. On the second of these journeys, you left your ship on the 7th of October, returning to her on the 25th, after an absence of 19 days, having travelled 111 miles, at an average rate daily of about 6 miles, in a temperature varying from +6° to -35°, averaging -14°, with strong winds, accompanied by two sledges, with ten and six men respectively?—Yes.

3883. (*Admiral Sir R. Collinson.*) Your expedition was across Melville Island, was it not?—Yes, to Hecla and Griper Bay, as far as Point Nias.

3884. Were you not away at all in the spring?—Not at all, only in the autumn. I went away for a short time shooting, but not travelling, not on a regular sledge journey; I had no travelling at all in the spring.

3885. Were you attached to the "Intrepid" during the whole of the period of two winters that you spent in the arctic regions. The whole time.

3886. You never were attached to the "Resolute"?—Never. I had the duty of the "Resolute" while Dr. Domville was away travelling, in the same way as he did the duty on board the "Intrepid" when I was away.

3887. The two vessels were not far from each other during the winter?—No, they were close to each other.

3888. So that you were frequently on board the "Resolute"?—Yes, constantly; nearly every day.

3889. Will you tell the Committee whether the accommodation on board the "Resolute" or the "Intrepid" was the best for the men?—The accommodation on board the "Intrepid" was better than on board the "Resolute."

3890. How was the "Intrepid" warmed?—There was a large fire on the lower deck always alight.

3891. Was there a Sylvester stove?—Yes.

3892. Was the Sylvester stove opened at the end of the pipes, or was it closed?—It was closed. The pipes did not go round the ship.

3893. The hot air did not make its escape, then, either into the cabins or on the lower deck?—No.

3894. The warmth was continued by the air in a chamber?—Yes.

3895. Had you a part of this piping in your cabin?—No, I believe it was in the former expedition; but it was stopped when we went out, it was cut off.

3896. How was your cabin warmed?—From a fire in the ward-room; the cabins were off the ward-room.

3897. Your cabin opened into the ward-room?—Yes.

3898. Had you much condensation in your cabin?—Yes, a great deal; we had constantly to clear the cabin out of ice, to scrape it out.

3899. Did you suffer from its dripping upon the top of you at night?—Yes, frequently.

3900. Did the same thing occur upon your lower deck in the case of the men?—Not to any great extent. It did at first, but when we kept up large fires the lower deck was comparatively dry.

3901. What means were taken on board the "Intrepid" to supply fresh air to the lower deck?—There was a ventilator.

3902. Was it an uptake or downtake?—An uptake.

3903. Did no other air arrive at the lower deck except what came through the doors of the hatchway?—I do not think there did, to the best of my belief.

3904. Was your hatchway covered?—No, there was a double door.

3905. All the fresh air that reached the lower deck came through the double door of the hatchway?—A good deal of it came from the galley. The lower deck was divided; the galley was foremost at the bows, and the lower deck came from that; so that a quantity of air would come from the galley into the lower deck; that would be a downtake, in fact.

3906. The galley formed an air chamber, which supplied the lower deck with fresh air?—Yes.

3907. Was the deck offensive at any time in consequence of the men being closed up together?—Not at all; it was very sweet and pure.

3908. What is your opinion of the ventilation on board the "Resolute," was it as good as you have described to us in the "Intrepid"?—I believe it was; on board the "Resolute," I think, they had a Sylvester's stove with tubing.

3909. You cannot tell whether that tubing was open at the end or not?—No; I cannot.

3910. Were your men healthy, generally speaking, throughout the winter?—Very healthy indeed.

3911. Do you think that the ration which was supplied to them was sufficient?—Yes; quite.

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3912. Was lime juice given to them regularly?—Every day from a very short time after we left England, till the day we came home, with the exception of those days when fresh meat was issued. By fresh meat I mean, musk-ox beef and reindeer, not preserved meat.

3913. Was the ration drunk in the presence of an officer, or were the men allowed to take it to their messes?—The men took it to their messes, but I have every reason to believe that they drank it; in fact the men were always fond of lime juice.

3914. Did you take any with you when you went on those sledge journeys?—None at all.

3915. Do you think it advisable to take it on sledge journeys?—I do not think you could, at least not in the present form in which it is supplied to the service.

3916. You, I believe, had no case of scurvy whatsoever?—No, none at all.

3917. What do you think was the cause that you were not subjected to this distressing disease?—We were well supplied with fresh meat; we had quantities of it; the men took their lime juice regularly; pickles were served out regularly every day from the time we left England till we came back, and a very fair quantity of vegetables; in fact, scurvy never entered into our heads at all.

3918. (*Admiral Inglefield*.) You stated that you believed that the men took their lime juice regularly after it was issued to them, that they were allowed to take it down below?—Yes.

3919. You have every reason to believe that they drank it?—Yes.

3920. And that thus their constitutions were in some measure prepared for their future work; do you believe that if they had not taken the lime juice that they would have been attacked with scurvy?—I think that if they had not taken it during the whole winter it is very probable that they would.

3921. From what you have heard, was there any difference in the quality or quantity of provisions issued in the late expedition, and that in the one in which you were engaged?—I am no judge of what was issued in the late expedition at all, but ours was first rate, both the salt and the fresh.

3922. Do you consider that lime juice deteriorates in the arctic regions?—Ours was always fluid, and certainly it did not deteriorate.

3923. Does the action of freezing, do you think deteriorate it?—Not when it is thawed again; I should not think it would.

3924. Were you employed on any sledge journey yourself?—Only under Sir Leopold M'Clintock. I went with him as his second in command. I was away thirty-eight days altogether.

3925. When the sledge journeys were equipped from the ship, in which you were medical officer, did you give instructions to the officer commanding the sledge as to the symptoms and treatment of scurvy?—I did.

3926. Full instructions and remedies?—Yes, full instructions and remedies.

3927. Was much game obtained in your expedition?—None at all.

3928. Was scurvy-grass and sorrel found?—Nothing of the kind; we ate nothing but our own provisions which we carried with us.

3929. Have you formed an opinion as to the proper age for the men on service similar to that of those employed in the arctic regions?—I think that no man ought to go there over 40.

3930. What is the lowest limit of age that you would fix?—I should say about 25 to 40.

3931. Was mustard and cress grown in your ships?—A small quantity.

3932. Was spruce beer issued to the men?—Yes, but only in a small quantity, brewed on board the "Resolute."

3933. Was it made on board or supplied to the ship?—Made on board the "Resolute."

3934. Did you carry beer as well?—Yes, we did.

3935. Made in England?—Yes; Allsopp's beer.

3936. Have you formed any opinion as to the use of tobacco by the men, was it advantageous or otherwise?—I think if one were a regular smoker it would do no harm at all, but if a person did not smoke he should never begin it up there.

3937. Has the question of acclimatisation been considered by you; do you consider that men may acquire the aptitude, if I may use the term, of living in that climate by having stayed some years in the arctic regions, or otherwise?—I should think that their health would deteriorate.

3938. The expedition which you were in was under Sir Edward Belcher, was it not?—Yes, it was divided into two.

3939. What was the condition of the men when they were taken on board the "Phoenix" at Beechey Island?—I do not know.

3940. Were you not there?—I was in the "North Star."

3941. I mean generally the whole party, because the whole party came together at Beechey Island; what was the general condition of the health of the crews that had wintered out there for two years?—Very fair indeed; some could have gone home, but several could have remained out. I volunteered myself to remain another winter. Four or five of us, Sir Leopold M'Clintock amongst us, volunteered if it should be deemed necessary.

3942. That I presume was when the question arose of waiting to relieve Captain Collinson, should he come through to Beechey Island?—Yes; Sir Edward Belcher thought first that he would leave the "Assistance" and "Pioneer," and he asked for volunteers, when Sir Leopold M'Clintock volunteered, and some others volunteered, and I volunteered with them.

3943. Was that before the "Phoenix" arrived?—Yes, that was on the 21st of August.

3944. Have you ever seen compressed tea used?—I have seen it in China, that is all.

3945. It was used in the late arctic expedition, and I want to know if you have had any experience as to whether it suffers by compression, or whether it is equal to ordinary tea?—I only tried it in China, and I did not think much of it then; but I do not know whether it was good tea or not.

3946. I believe in China it is only the commoner qualities that are compressed?—Yes; I believe so.

3947. Do you consider that issuing lime juice on the journeys would have been the means of keeping off scurvy in the recent arctic expedition?—No; I do not.

3948. To what do you attribute the outbreak of scurvy which has been so virulent in this expedition, and so different from other expeditions?—The prolonged darkness, the extreme cold, and the excessive labour which they had to perform in getting the sledges over hummocky ice, and besides that the dampness of the deck where the men lived, because of course the colder it is the greater condensation there is.

3949. I gather from you that the result of your experience is that the greater length of night, the excessive cold, and the extraordinary fatigue which the men of the late arctic expedition had to undergo, in combination with the dampness which naturally occurs on the lower deck, were the four conditions which you consider induced the outbreak of scurvy?—I think so.

3950. And of which the seeds were sown during the winter?—Yes.

3951. And they only germinated by the excessive fatigue?—Yes.

3952. Have you ever heard of scurvy among the Esquimaux?—Never.

3953. You undoubtedly consider lime juice an important antiscorbutic?—Certainly, and no expedition should leave it off altogether; it should be taken constantly.

3954. If it could be taken in a compressed form, or

in the shape of a capsule, upon any journey, would you not strongly recommend that it should be taken and issued daily on a sledge journey?—I should, but I think that if the "Alert" had been supplied with lime juice, scurvy would have broken out all the same, because I cannot understand how scurvy could have broken out two or three days after their leaving the ship and leaving off the lime juice. If so, lime juice is of no effect.

3955. In other words, the seeds were sown, and were germinating before they went upon the journey?—Yes.

3956. If it was a question with you to equip a sledge, and you could not take both tea and rum, to which would you give the preference?—If tea could be given to the men without their halting for an hour and a half, I should prefer tea, but I think halting for an hour and a half in the middle of the day, in that excessive cold, did the men more harm than good.

3957. Do you think there was no advantage from the rest, compared to their having to stand still for that time?—No, I think it was too cold.

3958. Can you make any suggestion with reference to the present enquiry, which has not been elicited from you by the questions which have been put, the enquiry being into the cause of the outbreak of scurvy in the recent arctic expedition?—I do not know what scale of rations they were on, but we were supplied liberally with pickles for one thing, we had bacon supplied to us instead of salt pork, and corned beef of a superior quality.

3959. Sir George Nares said that bacon was issued to the men on the sledge journeys?—Yes; I believe it was so, but we had it issued on board ship for ship use, instead of pork, and the salt beef was of superior quality, preserved on purpose for us at Deptford, corned in fact, not kept for years and years in salt.

3960. Will you examine the diet list of the late expedition, and having compared it with what was issued upon the voyage in which you were engaged, will you give the Committee the benefit of your opinion as to the difference which exists between the two, and the advantages or disadvantages which may occur to you?—Having compared the scale of victualing on board the "Intrepid" with that on board the "Alert," I find the advantage to be much in favour of the "Alert," thus:—

Vegetable	.. "Intrepid" had	7 lbs. monthly.
"	.. "Alert" "	7 lbs. with 7 oz. compressed.
Preserved meat	.. "Intrepid" "	5½ lbs. monthly.
"	.. "Alert" "	10½ " "
" soup	.. "Intrepid" "	3½ " "
		reduced to 2 lb. Jan. 3, 1853.
"	.. "Alert" "	3½ lbs. monthly.
Corned beef	.. "Intrepid" "	10½ " "
"	.. "Alert" "	7 " "
Salt pork or bacon,	"Intrepid" "	6 " "
"	.. "Alert" "	7 " "

The other articles of diet laid down in the scale were issued in similar proportions in both ships. But, it must be remembered, that in the "Intrepid" musk-ox beef and venison were issued occasionally; it must also be taken into account that the "Resolute" and "Intrepid" were supplied with 560 gallons of Burton ale, 3,500 lbs. of essence of malt, and 120 lbs. of hops. As regards the scale of diet for travellers, the "Alert" had 2 oz. of preserved potatoes per man per day; the "Intrepid" had none.

3961. (*Dr. Fraser.*) You did get lime juice tolerably regularly, I understand, on board ship?—After we had been on salt provisions for ten days; lime juice is always issued then.

3262. Not after you had been at sea for ten days?—No; after we had been on salt meat for ten days.

3263. Why did you give it?—It is an order from the Admiralty.

3964. Do you think the order a judicious one?—Certainly.

3965. Why?—It tends to preserve the health of the men.

3966. Does it preserve their general health, or does it tend to ward off any particular disease or diseases?—In ordinary ships, now-a-days, we never expect to see scurvy.

3967. Why do not you expect to see scurvy now-a-days?—It is a thing unheard of in the Navy, and I never saw a case of it in my life, except up in the arctic regions.

3968. To what is this present immunity usually considered due?—The men are never at sea for any length of time now, and when they are in harbour they get fresh meat and fresh vegetables.

3969. Do you say that the men are never out at sea for any length of time?—No, they are not; they might be, perhaps, making a voyage to the Cape, and then the chances are that they would touch at Madeira, or at Rio, or at Ascension, or at St. Helena.

3970. Do you think the ration of lime juice, therefore, unnecessary now-a-days?—No, certainly not.

3971. What do you think is the good of it?—As a preventive of scurvy.

3972. Do you know if that was the reason why it was given on board the ship in which you wintered in the arctic regions?—I should think so.

3973. Do you think that the beneficial effect of lime juice, which you have just mentioned, is restricted to board ship?—No, you could have it on shore.

3974. You could have it in sledge parties, could you?—I thought you were talking generally.

3975. I ask you, is this beneficial effect of lime juice restricted to on board ship?—Certainly not. In the Crimea they had scurvy, and lime juice there would have been most beneficial.

3976. Would you expect that it might be of great use in sledge journeys as well as on board ship?—If it could be taken.

3977. Do you expect that, if it could be taken, it would be beneficial on sledge journeys?—Yes.

3978. Why?—If the work was not too severe it would ward off scurvy, but in the present case of the "Alert" the cold was so intense, that the seeds had been sown during the winter, notwithstanding the men had been dosed with lime juice.

3979. I think that you have already told us that the seeds were sown during the winter, have you, anything further to add to those reasons?—I think not.

3980. Are you aware that the men before starting by those sledging expeditions were carefully examined on the medical officers on board, and certified as to their fitness for the work which they were about to undertake?—I am not aware of that.

3981. If you were aware, would you still be of opinion that scurvy had sown its seeds in the men previously to their starting on the expedition?—Certainly I should.

3982. You should imagine that its seeds might be sown without any effects being observable?—Certainly.

3983. How would you infer that the seeds were sown?—By its breaking out so soon after leaving off lime juice.

3984. Do I understand you to say, after leaving off lime juice?—Yes.

3985. You are aware, also, I daresay, that by no means all the cases of scurvy that occurred in the recent expedition manifested themselves within the first few days?—I have read no particulars whatever of the late expedition, except what I have seen in the newspapers.

3986. Then the opinion that the seeds of disease were sown on board ship requires the assumption, does it not, that the disease manifested itself generally within a few days after leaving the ship?—I believe the disease manifested itself within a few days after leaving the ship, and I think it is impossible that the

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disease could have shown itself if the seeds had not been sown in the winter.

3987. You found your opinion, that the seeds were sown in the winter, on the fact that cases of scurvy generally manifested themselves within a few days after leaving the ship?—Yes.

3988. Would you at all modify that opinion if you discovered that the majority of cases did not occur until perhaps ten or twelve or fourteen or more days after leaving the ship?—I call ten days a few days.

3989. Then you do think that those seeds were sown because of the cold and the dampness in the ships?—Cold and dampness, and perhaps the air on board the lower deck of the "Alert" was not so pure as it might have been.

3990. Cold, dampness, and bad air, is that what I understand you to say?—Yes.

3991. I think you have already told the Committee that you are aware that scurvy occurred in the Crimea; are you also aware that at that time the temperature was high?—My impression was that it was low, but I may be wrong, and that it occurred in the winter.

3992. You are not aware, are you, that during the Crimean war, scurvy occurred in the summer with a high temperature?—Yes it did, amongst the French and Sardinians, I know; I thought you meant amongst our troops.

3993. Then you still maintain the opinion that the seeds of scurvy are sown by cold?—By cold, dampness, and protracted darkness; I do not separate the one from the other.

3994. Do you think it requires the aggregation of those causes to produce scurvy?—I do; not to produce scurvy, but to sow the seeds of scurvy.

3995. Then, if one were absent, would the seeds notwithstanding be sown?—That does not follow.

3996. If that is your view, do you really mean to say anything more than this, that by being subjected to cold and dampness and darkness the general vitality of human beings may be lowered, and they may be made liable to suffer from any disease whatever, or do you mean to say that from these conditions scurvy is a usual or a necessary result?—Judging from the expedition which I was employed in, where the darkness was not so protracted, and the cold was not so intense, and there was not much dampness, and where the travelling parties left the ship, were absent in some cases 112 days and never saw lime juice, and yet had no scurvy at all, my impression is that protracted darkness, excessive cold and dampness, sowed the seeds of scurvy which broke out in the "Alert."

3997. Then do these conditions generally sow the seeds of scurvy, or do you mean to restrict them as causes to the recent arctic expedition?—No other expedition has ever been exposed to such trials as that, therefore the question cannot be answered. If another expedition went up and were exposed to the same circumstances, I have no doubt that the effects would be the same. In the ship that I was in we had, as I mentioned before the Committee, musk-ox beef and reindeer served out to the men, but in the "Alert" they had none.

3998. Do I rightly understand you to say, that in the arctic regions cold, dampness, and darkness will sow the seeds of scurvy, and in the Crimea high temperature, great dryness, and much light, will likewise sow the seeds of scurvy?—Certainly not. In the Crimea there was a deficiency of vegetables; indeed they had no vegetables for some time, but when they were supplied with vegetables the scurvy disappeared. In the arctic ships they had plenty of vegetables, at least we had, and I see by this dietary, that the "Alert" had, too.

3999. Then, I suppose, if you were now to learn that there was a deficiency in the supply of vegetables to the recent arctic expedition, especially to those who were engaged on the sledging parties, that might, in your opinion, account for the scurvy?—We had no vegetables whatever in the expedition

that I travelled with, not even preserved potatoes, and yet we did not take it, but I believe the "Alert" had.

4000. You do not think that the deprivation of vegetables is a cause of scurvy?—The travelling parties of the ship that I was in, the "Intrepid," during the winter were supplied with plenty of vegetables, and pickles and fresh meat, and these kept off the seeds of scurvy and enabled them to travel well, and they did travel well, and they came back better than when they started on the journey. They were thinner, certainly, from the exertion, but their health was just as good.

4001. I do not know whether you have the information, but perhaps you are aware that ten cases of scurvy occurred in connection with the "Discovery," and forty-four in connection with the "Alert"?—I heard so.

4002. Are you aware, further, that the difference in the exposure to darkness on the part of the two crews was a mere matter of a few days?—Yes.

4003. Do you think, therefore, that the prolonged darkness of only a few days, to which the crew of the "Alert" was subjected, would account for this enormous disproportion in the number of cases as contrasted with those in the "Discovery"?—It was because the men of the "Alert" were subjected to greater hardships in travelling than the "Discovery's."

4004. You do not then think that the darkness was a very important cause?—Yes, I do; the seeds were sown just the same.

4005. What knowledge have you of these "seeds"; have you any knowledge that there are such things as seeds of scurvy, or what do you exactly mean?—The men deteriorate in health. The ventilation might have been better on board the "Discovery"; the dampness was not so great.

4006. But the medical gentlemen, who examined all the crews, were unable to discover any deterioration in health?—I think that is very likely; you often cannot tell a person is ill, and the next day scarlatina might break out.

4007. Do you think they were ill before the scurvy appeared?—They might not be; they might be, to all appearance, in perfect health.

4008. They might be in perfect health when the medical officer examined them; is that what you mean?—No; I say they might not perceive it. If they had been well, I do not think scurvy would have broken out within ten days after leaving the ship.

4009. Then your opinion, that the cold, and dampness, and darkness were the causes of the scurvy, is very much an inference from the fact that scurvy occurred a few days after these men left the ship; is that so?—Yes, certainly. The "Discovery's" crew were supplied with fresh meat; the "Alert's" had none; that would account for it in a great measure.

4010. Now, I should like to understand you; you mean now to say that, in your opinion, the cold, the dampness, and the darkness were not the causes, but that the deprivation of fresh meat was the cause?—Certainly not; I do not say so.

4011. Then what influence do you think that the fresh meat exerted?—It gave stamina to the men. I had proof of that when I was up there; we had 13,000 lbs. of fresh meat, and no scurvy.

4012. And what was the exact influence of the additional quantity of fresh meat in one of the ships on the outbreak of scurvy?—It enabled the men of the "Discovery" to withstand the attacks of scurvy.

4013. Do you know what the difference of fresh meat was in the two ships?—The "Alert's" men had none, I believe.

4014. And do you know if the quantity supplied to the "Discovery" was large?—1½ lb. about three times a week. The "Discovery" had 3,053 lbs. of musk-ox beef.

4015. You have already expressed an opinion, as I understand, that the deprivation of fresh vegetable food is an important cause of scurvy?—Decidedly.

4016. And you have also said that your opinion is

that lime juice ought to be carried by sledge parties, if it can be done?—Certainly.

4017. What do you think are the chief obstacles to the carrying of lime juice by sledge parties?—In the present state as supplied to the navy it will freeze, and there are no appliances for carrying it in the navy. In bottles it will burst. And another great object to be considered is the weight. To thaw the lime juice you require fuel, which of course is a great object in travelling.

4018. Then, if these are obstacles that could be overcome, you think it would be necessary and proper that sledge parties in future should carry lime juice?—I do; certainly.

4019. From the description you gave of the Sylvester apparatus, I judge that it is more a heating than a ventilating appliance; is that so?—I think so. We had not it on board the "Intrepid" at all, so I cannot judge of it properly.

4020. (*Dr. Donnet.*) You say that the seeds of scurvy were sown among the crews during the winter months, and that they became developed under the influence of the causes which you have given both to Admiral Inglefield and to Dr. Fraser. Do you think that scurvy may undergo incubation in the system?—I have no experience of it at all; we had no cases on board the "Intrepid." The cases that I saw were all well developed, those that came over in the "Investigator."

4021. What particular symptoms of scurvy did you observe in these men?—Swelling of the legs, ecchymosis, lividity of the gums, the gums bleeding, great debility, general lassitude, weakness, loss of appetite, some of them had indolent ulcers, and they were in a wretched state altogether.

4022. Did these men come under your medical treatment?—Yes.

4023. What was the treatment you pursued?—Lime juice every day and plenty of vegetables and preserved milk and fruit, and touching the gums with solid nitrate of silver.

4024. You mentioned lime juice as a part of the treatment; do you attach much value to its curative effects?—Yes.

4025. I would like to have your opinion with regard to the use and effect of lime juice in the service generally?—I think it is a most valuable agent, when you are deprived, as ships are, of fresh vegetables. Now, in these days of steam, as I said before, you hardly ever see scurvy.

4026. You say that you consider it a valuable agent. May I infer from this that it is an agent against outbreaks of scurvy in the navy?—Yes.

4027. Do you attribute the immunity from scurvy, which the ships of the royal navy now possess, to the use of lime juice?—I do, in a great measure.

4028. You are, therefore, of opinion, that lime juice

is an article that cannot be dispensed with in the ships of the royal navy?—Certainly.

4029. And, therefore, more especially in arctic ships?—Yes.

4030. But I believe you consider that it is not necessary for sledge parties to carry lime juice?—If it were practicable they should take it, although in the "Intrepid" Sir Leopold McClintock was away 112 days, and had no lime juice and no scurvy; Mr. Krabbe was away seventy odd days; I was away for seventy-eight, and a French officer, M. De Bray, was away for a long time; and none of them took any lime juice.

4031. Were the instances of immunity from scurvy which you now mention attributable to any particular cause or causes?—I do not know whether Sir Leopold McClintock procured fresh meat; I believe he did while he was away travelling.

4032. What was the nature of the ground over which you travelled in your expedition to Hecla and Griper Bay?—Sandstone, very rugged. It was very undulating, and there were large stones in several of the places. Sometimes we could not go more than two miles a-day, and there was very little snow on the ground; it was soft and sludgy.

4033. Did you find any vegetation in the shape of moss, grass, sorrel or scurvy-grass?—We saw some moss; that was all; no sorrel or scurvy-grass at all, at least none to eat. We might have seen a little bit here and there, but we did not eat any.

4034. Did you succeed in getting any fresh meat?—No, none at all; never shot anything.

4035. (*The Chairman.*) What was the general character of the ice over which your journeys were performed?—When first we started the ice was very thin indeed, and we had not left the ship more than four hours before one of the carts went in through the ice, it was so thin, with all the bedding; and I was obliged to return to the ship to have it dried, and started again the next morning when it was all ready.

4036. And did you pass through snow of any depth?—We did in the ravines on the land, not on the ice.

4037. Have you read the reports of the sledge journeys performed by the late expedition, and how do they compare in point of difficulty with those performed by you, first as regards the land journeys, and secondly, as to that over the ice to the north?—The ice that we travelled over was comparatively smooth to what the late expedition encountered.

4038. In your journeys were any of your men effected by scurvy, or by symptoms which you would now be disposed to consider scorbutic?—No, they were not.

4039. To what do you attribute their immunity?—We had only lately arrived out from England, and the men were in perfect health and had not had a winter out there.

R. C. Scott,
Esq., Fleet-
Surgeon, R.N.

22 Jan., 1877.

The witness withdrew.

Adjourned to to-morrow at 11 o'clock.

TUESDAY, 23RD JANUARY, 1877.

PRESENT:

ADMIRAL SIR JAMES HOPE, G.C.B., in the Chair.

ADMIRAL SIR R. COLLINSON, K.C.B.

VICE-ADMIRAL E. A. INGLEFIELD, C.B., F.R.S.

JAMES J. L. DONNET, ESQ., M.D., Inspector-General of Hospitals and Fleets, R.N.

THOMAS R. FRASER, ESQ., M.D., F.R.S.E.

H. J. VANSITTART NEALE, ESQ., Secretary.

CHARLES EDE, ESQ., F.R.C.S., *examined.*

4040. You were formerly in the navy, and were assistant surgeon in the "Assistance" in 1850-51?—Yes.

4041. Will you state to the Committee what arctic expeditions you were engaged in, and in what capacity?—The expedition of 1850 and 1851, under Cap-

C. Ede, Esq.

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C. Ede, Esq. tains Austin and Onmanney. I was on board the
23 Jan., 1877. "Assistance" as assistant surgeon.

4042. Will you enumerate the sledge journeys in which you were personally engaged?—One in the autumn for a week, and in the spring for 20 days.

4043. (*Admiral Sir R. Collinson.*) With respect to the diet on board the "Assistance," do you think it was sufficient to maintain the men in health during an arctic voyage?—Yes; on board the ship it was.

4044. Have you seen a list of the diet that was on board the "Alert" and "Discovery"?—No; I have not.

4045. Will you cast your eye over this (*handing a paper to the witness*), and see if there is any difference between the two?—The diet is similar; it does not say whether the chocolate was with milk. I think our chocolate was with milk; that is the only thing that I see. I do not think that we had any fruit. We had preserved vegetables, and the same amount of lime juice was served out; and we had some sugar-beer that we made on board.

4046. Do you think that sugar-beer was an antiscorbutic, or simply a refreshing drink?—Slightly antiscorbutic, I should say.

4047. Was the lime juice taken regularly on board the "Assistance"?—It was taken regularly on board every day.

4048. Was it served out at the tub, or allowed to be taken to the messes?—The officers took it at the mess, and the men took it at the tub.

4049. Were there any men that refused to drink it?—I do not recollect any one refusing to drink it.

4050. You were warmed by a Sylvester stove, were you not?—Yes.

4051. Did that pass through your cabin?—Yes.

4052. Was there any opening for the hot air to escape?—There was a grating, I think; round, if my memory serves me, but I would not be positive about it; not into the sleeping cabins.

4053. But do you think that the end of the stove was open, so that the hot air made its escape on to the lower deck or into the captain's cabin?—I do not think it made its escape anywhere below the deck.

4054. Consequently, you think that the same air that was heated returned back to the stove, and was sent throughout the ship over and over again; or was there any fresh supply from the upper deck?—I think there was a fresh supply from the upper deck, but I would not be positive about it; it is so long since.

4055. What were the means taken for ventilating the lower deck on board the "Assistance"?—The hot air naturally tended to ventilate it, passing round the ship and through the cabins, and then the hatchways were kept frequently open. I do not recollect any windsails.

4056. Had you any downtakes?—Yes, I think we had.

4057. And any uptakes?—No, I do not think so; I think it was merely through the hatchways.

4058. Had you any tanks over the main hatchway; were there manholes for the heated air to go up by?—No; I think not.

4059. What was the condition of your lower deck, generally speaking, during the winter?—The air was tolerably pure; I should say unusually so, under the circumstances. The lower deck was constantly emptied, by the men being sent out in the day-time, and sent on to the upper deck.

4060. Had you much drip?—Not very much.

4061. Did you visit the "Resolute" during the winter?—Yes.

4062. Was there any difference between the ventilation and the steps taken on board the two vessels, or were they similar?—Very similar, but I think ours was better ventilated than the "Resolute." I used to notice the difference when I went to the "Resolute"; it might have been from crossing the fresh floe, and going into the ship after that. But I should think, of the two ships ours was the better ventilated.

4063. Could you specify any difference; were your hatchways larger, or was any extra combing placed

over the hatchway?—No, I think we had more room between decks; we were slightly higher than the "Resolute."

4064. What was the condition of the health of your men before they started on their sledge journeys?—Uncommonly good.

4065. Had you any cases of scurvy?—No, no traces of scurvy.

4066. When you started for your sledge journeys in the autumn, was your provision very different to that which was issued on board the ship?—Yes, it was rather different. We confined ourselves to pemmican and pork, and chocolate and milk, and on one occasion we did not take lime juice, not in the autumn; we were merely going to communicate with Captain Penny's ship, some miles from us.

4067. Did your men suffer from frost-bites on that autumn journey?—No, not on the autumn journey.

4068. And on your return, after seven days' absence, I believe none of the men were ill, or were compelled to go upon the sick list?—No, they came back in perfect health.

4069. On your spring journey, were you provisioned in a similar manner?—Yes; we had pemmican, salt pork, ship's biscuit, chocolate, and some tea, the usual sledge provisions I think. I do not think there was much difference.

4070. Did you take lime juice?—Yes, we took lime juice.

4071. Had you any difficulty in carrying it?—None whatever.

4072. How was it carried?—In bottles. One bottle broke from the frost, but the men used the lime juice all the same. It was not so solid but what it easily broke from pressure.

4073. What quantity did you give them?—Two drachms, I think, of the pure juice per man a day; a quarter of an ounce a day.

4074. That is to say, a much smaller quantity than you gave on board ship?—Yes, a smaller quantity.

4075. What time was it administered?—It was administered when we halted for our principal meal in the evening.

4076. Was it given before or after the food?—I think the men generally drank it before. When it was frozen they took it in small flaky masses, and put it into their mouth, and took it in that way.

4077. Did you taste it in that way?—Yes; I took it myself.

4078. What was your personal opinion with respect to it?—I thought it was very good; equally good with that in a fluid state.

4079. Was it equally efficacious?—Yes; equally efficacious.

4080. Did it assuage their thirst?—Yes; the men prized it very much, and expressed themselves so. I find a note at the end of my journal, on looking it over within the last day or two: "Lime juice much prized by the men."

4081. (*Admiral Inglefield.*) You stated that the men took their lime juice on the quarter-deck, and therefore you are certain that it was all consumed; did you ever hear of the case of a man who objected to it, or avoided it?—I cannot recall a case; there may have been one; I do not assert positively that there was not.

4082. Generally speaking, I gather from you that the men looked forward to it with pleasure, and took it with satisfaction?—Yes.

4083. And that you found no difficulty in carrying it upon the sledge?—No.

4084. And that you did not use fuel for thawing it when it was frozen?—No.

4085. The quantity that would be required for an eight-man sledge, would be how much per diem?—About two ounces; a quarter of an ounce each man per diem.

4086. And carried in a stone bottle, which holds how much?—I think they were quart bottles, if I recollect rightly.

4087. How many rations would there be in those

quart bottles?—Very nearly ninety rations for each man.

4088. You had nine men for eighty-five days; the quantity of lime juice, roughly, that they would have carried to give each man his ration of a quarter of an ounce would have been what?—A quart would last ten days for nine men, and if they were away eighty days they would have taken eight quarts.

4089. Then, in fact, two gallons of lime juice in the state in which it is issued now to the ships' companies, would have been sufficient to have lasted that extended sledge journey for the whole time, giving each man a ration of a quarter of an ounce a-day?—Yes; it would be about equal to that per man per day.

4090. Is it your opinion that, when an outbreak of scurvy occurs, or even before the outbreak, lime juice acts as a powerful antiscorbutic?—Undoubtedly.

4091. Is it also your opinion that, if these men had used lime juice in the way it has been suggested, and as it was used upon your sledge journeys, probably the scurvy, though it might have broken out, at all events would have been in a less severe form?—Always provided they had taken it previously on board ship.

4092. That is an admitted fact, that they did take it on board ship, but did not take it on the journeys. Have you made yourself acquainted with the particulars of those sledge journeys?—I have not gone into it thoroughly; I have looked through the published accounts.

4093. Do you consider that lime juice in any way deteriorates in arctic regions?—No.

4094. You were with a sledge party yourself, I believe?—Yes, I was; for three weeks; away twenty days.

4095. Was there any scurvy in your party?—None whatever.

4096. Then your assistance as a medical man was of no special avail on those journeys?—Except that I brought back three frost-bitten men, and two that were snow-blind, from the party that I was with.

4097. Then you were able to treat them on the spot?—Yes, I treated them as we travelled back.

4098. Did the officers in that sledge journey work like the men?—Only under certain circumstances, when there was any difficulty. When we met with great masses of hummocks, larger than usual, sometimes they would clap on to the drag-rope, but not generally.

4099. Was rum and tea issued on those journeys?—Yes.

4100. To which do you give the preference?—To tea.

4101. And on what grounds?—The spirit produces a little excitement for a time, but the reaction is so rapid in those regions that the depression is greater than the value of the excitement.

4102. Then you would suggest, I presume, that some rum should be taken?—Yes, a small quantity.

4103. To be used at what time of the journey?—I should use it just before turning in at night, when the men were exhausted, to give them a slight fillip before their meal.

4104. And tea for their midday meal?—Yes, tea for their midday meal, when they were undergoing exertion.

4105. Have you formed any opinion with regard to acclimatisation; I mean whether men, on getting accustomed to the climate, are better able to withstand the rigours of an arctic season?—Always provided that their dietary is good; not otherwise.

4106. Have you formed any opinion as to the age that the men should be who are engaged in those voyages?—Yes, they should certainly be from 25 to 30; that, I think, is the best age.

4107. But not older?—Not older.

4108. In your journeys, did you find much game?—Not much on our journeys; only white hares, and a bear or two.

4109. Did you use sorrel and scurvy-grass?—We found it on our return to Carey Islands; there was a

large quantity there of *Cochlearia Greenlandica*, or Greenland cress.

4110. Did you grow mustard and cress on board?—Yes.

4111. In any large quantity?—Not in a large quantity, but a fair quantity.

4112. Did you find that beneficial?—It was always liked, and I believe it to have been beneficial.

4113. In what condition were the crews of your ships when you returned from Captain Austin's voyage?—In very good condition.

4114. Were they equal to withstand another winter?—Yes.

4115. I think you were there two winters?—No, only one winter. Many of the officers and men volunteered for a second winter.

4116. Have you ever seen compressed tea taken?—No, I have never seen it taken.

4117. Have you ever heard of scurvy amongst the Esquimaux?—Yes.

4118. To any extent?—Yes, in some of the settlements.

4119. Were they amongst the barbarous or the semi-civilised Esquimaux?—Amongst the semi-civilised in Greenland; there is no record of it amongst the barbarous tribes.

4120. Did you fall in with any Esquimaux at Whale Sound, or Cape York?—Not at Whale Sound, but at Cape York we did. Personally, I saw no traces of scurvy amongst them; it was only hearsay.

4121. I should like you to assure us, once more, of your decided opinion as to the great necessity of carrying lime juice on sledging journeys?—Yes; my opinion is, that it decidedly ought to be carried.

4122. And that the necessity of taking fuel for melting it is not an insuperable difficulty?—No; certainly not.

4123. As you have, in your own case, used it by thawing it in your mouth when frozen, and the men have partaken of it in the same manner?—Yes.

4124. Have you any other information which you can give the Committee, with reference to the present enquiry, which no question has been put to elicit?—I recollect in the Pacific, being in a 50-gun frigate, where we had scurvy, though we took lime juice. It was very slight indeed, but there were symptoms of scurvy coming on after after six or eight months living on salt beef, salt pork, and ship's biscuit, and nothing else.

4125. What do you consider the advantages of raw potatoes compared with Edwards's potato?—I should give the preference to the raw potato. The American expedition, De Haven's expedition, of which Dr. Kane was the medical officer, used raw potato as a salad with onions. The raw potato and the onions were sliced very thin in a salad, and, in fact, they found it very beneficial.

4126. (*Dr. Fraser.*) You have had no experience of scurvy in the arctic regions, I think?—No, not in the arctic regions.

4127. To what do you attribute that immunity which you have mentioned?—Partly to the use of lime juice, partly to ventilation; to the general care of the men; the exercise on the floe constantly during the winter, and, I think, partly also to the advantages which we had in reaching the arctic regions. We had a great number of birds there, and also on one occasion we brought off twenty-one dozen of eider-ducks' eggs, and on another occasion twelve dozen of looms' eggs. I consider that the egg is a most useful thing in scurvy.

4128. (*Admiral Inglefield.*) Did you get those at Cape Shackleton?—Yes, and at Woman Island, and the Carey Islands again coming back. I think we brought off 550 looms in one day, and we got scurvy-grass in Carey Islands. We brought off a large number of terns' eggs on another occasion, and the men partook of those eggs very wisely.

4129. (*Dr. Fraser.*) You collected more eggs than could be used in a few days?—Yes.

4130. How did you preserve them?—They kept

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very well; they kept for some days the same as ordinary eggs.

4131. You had two sledge excursions, had you not, whilst you were with the "Assistance"?—Yes, and one shooting party of nearly a week.

4132. Were they dog or man-sledges?—Both were man-sledges.

4133. You were absent from the ship for a longer period on the second than on the first occasion?—Yes; 20 days on the second occasion.

4134. That was also a man-sledge?—Yes.

4135. Can you recollect what weights were dragged?—About 187½ lbs. per man, I believe.

4136. Was that weight maintained throughout the three weeks, excepting, of course, the diminution from the rations consumed?—Yes, except of course the consumption of rations, and the fuel.

4137. About what was the temperature?—Our lowest temperature was -35° .

4138. In what month was the second expedition?—It was April 15th.

4139. How many men had you on the second expedition?—Seven.

4140. Was that including officers?—Six men and one officer.

4141. Then the whole party consisted of seven?—Yes.

4142. Was the dietary the same as that in the autumn expedition?—Very nearly.

4143. You have already told us that there was no lime juice with that expedition, excepting the jar which you took?—Yes.

4144. Can you further tell us if the dietary was similar or the same as this which I show you, which is the dietary of the sledge parties in the recent expedition (*handing the same to the witness*)?—We had no stearine; we had nothing but spirits of wine for fuel. We used some rum on one or two occasions for fuel, and we had no onion and curry powder. I think, with those exceptions, the diet was almost identical, if not quite.

4145. Do you remember if you had the same quantity of preserved potato, or more or less?—I think we had less preserved potato.

4146. Do you think you had more than two ounces of preserved potato?—I do not recollect.

4147. During this expedition of three weeks, with a party of eight, what was the total quantity of lime juice that you started with?—I do not recollect.

4148. And you served out a quarter-of-an-ounce as a ration?—Yes.

4149. Which was sometimes frozen?—Yes; sometimes it was frozen.

4150. You did not at any time require to melt it?—No; we did not melt it.

4151. How did you get it out of the bottle?—We broke the neck of the bottle.

4152. Did it appear to you, from the means of information which you had, that the lime juice was of equal quality throughout the bottle; I mean that there was no appearance of any ingredients of the lime juice having collected in one portion of the bottle?—One could hardly say that; I did not observe it very much.

4153. No difference of that kind was seen by you?—Not of any amount, if there was any at all; and I can hardly say that there was any.

4154. Was it a hard mass of frozen lime juice, or was it a loose substance?—It was a friable mass, easily broken down; it was not perfectly solid, not like a solid lump of ice. It was kept covered up on one of the sledges, and that would make some difference.

4155. Was it quite dry?—No; not quite dry.

4156. So that you had no difficulty in issuing it?—No difficulty whatever.

4157. How did you measure a quarter of an ounce?—Roughly; we gave them a piece each all round, until it was gone; one of those flaky bits; it flaked off with the least pressure.

4158: You might have given more?—We might

have given more or less; we made a rough guess at it.

4159. Do you say that you gave a quarter of an ounce of this juice without any dilution?—Yes, they took it without dilution.

4160. It was simply put into the mouth?—Yes.

4161. And no bad effects followed?—No bad effects whatever.

4162. Did it not irritate the mucous membrane in the least?—Not in the least.

4163. And they had no diarrhoea?—No.

4164. And no dyspepsia?—No dyspepsia whatever.

4165. You said you thought that it was beneficial rather than otherwise in this form, in so far that it assuaged thirst?—Yes, it assuaged thirst; I enjoyed it myself.

4166. As a rule, however, when you issue liquid lime juice, do you not consider it necessary to dilute it considerably?—It may or may not be diluted, just as people will take the juice of a lemon pure or with water with it in this country.

4167. So far as your experience goes, have you not in the treatment of scurvy, when you have given lime juice, found it necessary to dilute it?—We generally diluted it when we had the means.

4168. Why?—Because it is more agreeable.

4169. Did you ever know it in its undiluted form, to produce irritation of the mucous membrane?—I have never met with cases under those circumstances.

4170. But have you known cases where it has been taken undiluted without producing irritation of the mucous membrane?—It might produce irritation in diseased people, but not in healthy people.

4171. Was your party of seven throughout this three weeks' expedition in very good health?—The people that I brought back were frost-bitten and snow-blind. I gave up my healthy men to the sledges that were going forward, and I brought back the diseased ones (if you like to call frost-bite and snow-blindness diseases) with me from the party that was going on further.

4172. There were no symptoms of scurvy presented by these men, were there?—None whatever.

4173. No marked prostration?—No.

4174. And no pains?—No, none whatever.

4175. And no mental despondency?—Not the least; they were very cheerful.

4176. And no discolouration of the skin?—Not the least, except from the frost-bites; there was discolouration of course from that.

4177. You had an opportunity of assuring yourself at the end of the expedition that there were no scorbutic discolourations?—Yes, there were no scorbutic symptoms. I do not know that I examined them all over. I very much doubt if I did; but, so far as I can say, I do not think there were any discolourations.

4178. No sponginess or affection of the gums?—No, none.

4179. So that, in fact, you had not the slightest reason for supposing that there were any scorbutic symptoms?—No, not the slightest reason to suppose so.

4180. How did you generally cook your food in a sledge expedition?—We used spirits of wine. The pemmican was broken up into pieces with a cold chisel and mallet, and put into a tin with the spirits of wine underneath, generally with biscuit powder or potato. The pork was eaten cold.

4181. Did you mix the vegetables with the pemmican when the pemmican was cooked?—No, we carried no vegetables on the sledging party.

4182. I thought you said you carried potato?—With the exception of that; I mean we carried no compressed vegetables.

4183. How was the potato used?—It was mixed with the pemmican sometimes, but more frequently we used biscuit crumbs.

4184. The potato having been previously cooked, I suppose?—Yes, the potato was cooked in our expedi-

tion. It was Edwards's preserved potato that we took.

4185. You told us that you obtained at various times supplies of Greenland cress; did you obtain any during your sledging expedition?—No, not during the sledging expedition.

4186. Did you obtain any vegetables during your previous expedition?—During a shooting expedition I used the flower of the saxifrage to mix with my pemmican.

4187. Was that used by your men in the autumn expedition?—Yes; by the whole of our party.

4188. Throughout the seven days?—Yes; throughout the seven days.

4189. You had no fresh vegetables, I think, during the spring expedition?—No.

4190. What is your opinion as to a liberal supply of condensed or desiccated milk as a diet for sledging parties?—Highly advantageous, and most desirable.

4191. Have you any experience of desiccated milk?—Not of desiccated, but of condensed milk, the ordinary Swiss milk.

4192. You think it highly advantageous; but have you any idea that it is antiscorbutic?—It contains all the elements of life, and therefore it must be antiscorbutic.

4193. You mean that it contains all the principles which a proper food ought to contain?—Yes, quite so, all the elements of life; it is the natural product for the purpose of building up the young animal, in fact.

4194. It contains, in what appears to be the proper proportion, albuminous and fatty constituents, and carbo-hydrate and mineral constituents?—Yes.

4195. Have you an equally high opinion of the advantage to be gained by the addition of eggs to arctic diet?—Decidedly. I should suggest that eggs preserved in vinegar would be a convenient form; that is to say, boiled hard and pickled.

4196. Have you experience of that method of preservation?—Yes.

4197. What experience have you had?—I have eaten them myself, and I constantly use them; they will keep a great many months. I cannot give you the exact limit of time, because I have never tried it, but I know they keep six months readily, or even more.

4198. Just tell us exactly what this preparation of eggs is?—Simply hard boiled eggs, the shells taken off, and boiling vinegar poured over the eggs.

4199. Is it a pleasant food?—Very nice indeed; especially with cold meat. I should think it would be very agreeable with pemmican, and make an admirable addition and variety.

4200. Are you aware that ordinary eggs can also be kept quite six months?—Yes, they can, but then they are not nearly so nice; they generally have a very disagreeable flavour after that time; they are getting shoppy, as we call it. That is my experience.

4201. You told us, I think, that although you had fortunately no scurvy during your arctic experience, you had while in the Pacific Ocean?—Yes; no very bad cases, but decided cases of incipient scurvy.

4202. Would you tell us what symptoms were manifested in those cases?—We had the discolourations of the skins and sponginess of the gums, and slight bleeding.

4203. It was more than incipient?—It was beginning to be more than incipient; we had 50 men ill out of a crew of 500 on board when we went to the Sandwich Islands and anchored at Honolulu, and in less than a week, after living on fresh vegetables, the number on the sick-list was reduced to five, because at Honolulu we had plenty of bananas and melons.

4204. How long had you been absent from land before the outbreak?—I think we had been on salt beef and pork and ship's biscuits (the beef had been 14 years in salt out on the station) for over six months, and the biscuit had been made in Mexico, and was full of weevils.

4205. Then your provisions were extremely bad?—

Yes, they were extremely bad; but we had lime juice at that time.

4206. Was that good?—Yes, the lime juice was good, and it was served out every day.

4207. What means had you of being certain that it was good?—From experience.

4208. From what you know of the properties of lime juice?—Yes; but for that, the proportion of men attacked would have been infinitely larger.

4209. What doses were served of the lime juice during these six months?—Half-an-ounce a-day, if I recollect rightly.

4210. Had the men, before the outbreak, shown any symptoms of being badly nourished?—Yes, the men were getting pallid, and weak, and inert, showing all the symptoms of depraved nutrition, in fact.

4211. Was that general throughout the crew, and not restricted to the men who afterwards exhibited symptoms of scurvy?—Almost throughout.

4212. Did you carry no vegetables with you on that occasion before touching at Honolulu?—No, we had only preserved potatoes.

4213. What were they?—The same kind that we had in the arctic regions, Edwards's.

4214. What was the ration of preserved potatoes?—I cannot tell exactly; it was not very large, it was a very small amount. I think in our mess we had not potato more than twice a week; but I am speaking from memory, as it is 28 or 30 years ago.

4215. What is your impression of the quantity served to the crew, was it less or more?—Less.

4216. These were the only vegetables that you had?—Yes, the only vegetables that we had at the time I am speaking of.

4217. About what was the temperature at the time at which this outbreak occurred?—We were running down the trade-wind. I do not know exactly what the temperature was; it was a very good temperature, about 70°, or rather warmer than otherwise; a little over temperate.

4218. You obtained a liberal supply of fresh vegetables, I think you said, at Honolulu; did you obtain supplies of any other food?—Yes; we had fish, and pork, and poultry, brought off to us.

4219. In fact, the whole diet was changed?—Yes; changed at once.

4220. And no further cases occurred?—No further cases occurred; and the whole of them got well.

4221. You have, from what you have already told us, I think, served in several of Her Majesty's ships?—Yes.

4222. Can you inform the Committee what is the usual cubic space allowed to men on board Her Majesty's ships for living and sleeping?—I cannot very well; it is a rather difficult thing to obtain. In the ship in which I was serving, where the scurvy occurred, which was a 50-gun frigate, the men were berthed forward, and I could not give the exact cubic space.

4223. You were generally satisfied with the condition of the air, were you, in the sleeping berths?—Yes, the main-deck ports could always be opened right away along where they slept; there was no difficulty in ventilating the deck.

4224. Is your experience of scurvy limited to this outbreak in the Pacific Ocean?—I have seen two cases lately of agricultural labourers in England, which occurred after the winter.

4225. Can you give us any details of these cases?—They had been living upon pork, and bread and beer.

4226. Where was that?—It was in Surrey; they had been living without any fresh vegetables, so far as I could gather. They were young men of about 20 or 21, and they had distinct symptoms of scurvy, which symptoms all disappeared when I put them upon a lemon a day. The only treatment I adopted was to give them a lemon a day each.

4227. You did not find it necessary to add any vegetables in these cases, did you?—They did not take any vegetables; it was just at the end of the

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winter. I should have added them if they could have obtained them readily.

4228. But, as a fact, you did not?—I did not; I found that the lemon was quite sufficient.

4229. Had those men liberal allowances of pork, bread and beer previously to their illness?—Yes, they had plenty of pork, bread and beer.

4230. They were not in poverty?—No; they were not in poverty.

4231. They were fed well according to their notions?—Yes; according to their idea.

4232. That, I believe, is not a very uncommon experience in this country?—Not very.

4233. Many similar cases have been recorded, I think?—Yes; we have cases of that sort.

4234. (*Dr. Donnet*). What was the nature of the snow over which you travelled during your sledge journey?—In the autumn it was fresh fallen and soft, most of it; in the spring it was frozen and hard, the greater part of it.

4235. What was the depth of the snow?—I can hardly say exactly; it is difficult to know where the snow ends and the ice begins. On the floe it was not very deep, but on the shore and in the ravines it was very deep in places.

4236. You say that the drip was not troublesome on board the "Assistance," was this owing to the better ventilation and to less condensation of moisture?—I should say so; it was troublesome, but not very.

4237. Do you think that the amount of moisture was diminished by the greater heat produced by the Sylvester stove?—Yes; the moisture was driven off by the heat of the Sylvester stove.

4238. Can you tell me what amount of coal was required per diem for the Sylvester stove?—No; I do not recollect exactly.

4239. Did you visit the ship of the American expedition under Captain De Haven?—On one occasion.

4240. Can you tell me what precautions were taken against the condensation of the moisture on the living deck of that ship?—No, I was not there sufficiently long to notice it.

4241. You mentioned that lime juice was taken on your journeys pure, though frozen; would not sugar have added to the antiscorbutic properties of this lime juice?—I should say it would. It is a food, and therefore anything that goes to nourish the system would tend to be an antiscorbutic.

4242. Do you know whether on board American ships, molasses is used as an antiscorbutic?—I believe it was; molasses and pork I think they used to eat together, if I recollect.

4243. Would you recommend lime juice to be taken solid as you describe?—I should prefer it in a fluid state, if it was possible to keep it fluid. It is more easily served out in a fluid than in a solid state.

4244. Without the addition of water, do you mean?—I prefer it with the water, certainly.

4245. Did you find it very difficult to thaw sufficient water for the use of your sledge party?—It took some time to thaw the snow.

4246. Can you say what time it took?—It took half an hour to get our tea ready; and rather longer for our pemmican, and rather longer for the evening meal, because they had more to cook.

4247. Can you remember the temperature at the time of the encampment?—Our lowest temperature was -35° .

4248. And did you travel by day, or by night?—By night.

4249. I believe you attach great value to lime juice as an antiscorbutic?—Yes.

4250. Do you consider it a necessary article of diet for a sledge journey?—Yes, where there are no fresh vegetables.

4251. What was the nature of the snow-blindness from which your men suffered on your sledge journeys; was it paralysis of the retina, or inflammation of the conjunctiva?—Exhaustion of the retina in two cases, and one from inflammation of the conjunctiva.

4252. What remedies did you use?—We used the tincture of opium, or vinum opii.

4253. Have you any suggestions to make towards improving the scale of victualling which I now lay before you, and which was observed on board the late expedition?—There is no condensed milk mentioned here, and I should certainly advise condensed milk; and I think that fruit, tamarinds preserved without stones, would occupy but small space, and they contain a very powerful vegetable acid, and cranberries also would be good. I do not know whether onions are mentioned, it says compressed vegetables; preserved vegetables is very vague. I do not see either butter or cheese mentioned, and I should advise butter, and a certain small amount of cheese would be very beneficial for the nutritious matter which it contains.

4254. What suggestions can you offer regarding the arctic sledge dietary, a copy of which I place before you, and which was used in the late arctic expedition (*handing same to the witness*)?—Lime juice is omitted. Lime juice and preserved milk I should like to add.

4255. Do you think that the absence of light has any deteriorating effect upon the constitution of man?—Undoubtedly.

4256. Have you observed any evil effects caused by its absence?—I believe, from my recollection, they were very much blanched and pallid after the winter, showing that the red blood is deficient in the system. All the men looked pale and blanched when the sun returned to us.

4257. Did your men lose this pallor after they had been some days travelling?—Yes, when the sun returned; after the return of the sun they began to improve.

4258. Have you formed any opinion about the causes which produced the outbreak in the late expedition, and if so, to what cause or causes do you attribute this outbreak?—No; I cannot say that I have formed any positive opinion. Do you mean on board the ship or the sledges?

4259. I mean in the whole of the expedition, whether on board the ship or in the sledge parties?—I am not sufficiently acquainted with the whole of the details to say at present.

4260. (*The Chairman*). What was the general character of the ice on which your journeys were performed?—It was rough and broken into hummocks.

4261. And what was the depth and character of the snow?—We had a fresh fall, and then the snow was very deep, but at our first starting we had very little depth of snow; the snow was hard at first, but after the fall it was very soft; we sunk quite a foot or rather more in it. Of course, it was more when we came across drifts.

4262. Have you read the reports of the sledge journeys performed by the late expedition, and how do they compare in point of difficulty with those performed by you: first, as regards the land journeys east and west along the coast; and, secondly, as to that over the ice to the north?—Over the ice to the north the difficulty was certainly greater than in our case, but I should say also in the land journeys from the depth of the snow. The snow appeared to be more uniformly deep with them than with us, it was only deep in places with us.

4263. In your sledge journeys were any of your men affected by scurvy or by symptoms which you would now be disposed to consider scorbutic?—No, they were not.

The witness withdrew.

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DAVID LYALL, Esq., M.D., Deputy Inspector-General of Hospitals and Fleets, R.N., *examined*.

4264. (*The Chairman*). Will you be kind enough to enumerate the arctic expeditions in which you were

engaged?—I was only in one arctic expedition. I was in the antarctic expedition under Sir James Ross, from

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1839 to 1843; and in the arctic expedition of Sir Edward Belcher, 1852-54.

4265. In what ship?—The "Assistance."

4266. Were you personally engaged in any sledge journeys, and, if so, will you enumerate them?—The sledge journeys in which I was personally engaged, were:

1st. 3rd August to 8th September, 1852.

2nd. 10th April to 3rd May, 1853.

3rd. 8th May to 23rd May, 1853.

4th. 28th May to 24th June, 1853.

5th. 11th September to 13th September, 1853.

6th. 17th April to 21st April, 1854.

7th. 15th May to 18th May, 1854.

8th. 22nd August to 26th August, 1854.

4267. (*Admiral Sir R. Collinson.*) In the "Assistance," what arrangements were made for the ventilation of the lower deck?—In the first winter there were two ways of getting from the lower deck, the hatchway between the captain's cabin and the gun-room, and the main hatchway. Over each, there was a sort of tent. I am not very clear about the first winter, but in the second winter, there was a great improvement in the way in which the ventilation was carried on. There was a sort of house built over the hatchway, with a double door to it, so that when any person went on the upper deck, or came from it, the cold air did not rush down to the lower deck, as it would have done, if it had only been a single door.

4268. Were there any uptakes from the lower deck?—I do not recollect any except the hatchways. Of course, from the fires there was ventilation from the funnels, from the cooking apparatus, and from the Sylvester stove, and from the stove in the officers mess place, and in the captain's cabin.

4269. Was the house that you say was built over the upper deck built over the main hatchway, or the hatchway forward; where was the ladder?—It was over the main hatchway.

4270. Then you had another ladder communicating from the lower deck further forward, had you not?—There were two ladders; there was one for the officers and one for the men.

4271. But before the ship was housed in, were there not two communications from the lower deck up to the upper deck?—Yes.

4272. The fore hatchway?—Yes.

4273. Was the fore hatchway made use of in the winter to go on deck at all?—No, not to the best of my recollection.

4274. Were there any tanks with man-holes placed over that fore hatchway, so as to take the heated air into the tank and let it condense?—Yes.

4275. Do you think that was beneficial?—I think so.

4276. Are you aware whether those tanks were obliged to be frequently cleaned out, so much snow having accumulated inside them?—Yes, frequently.

4277. The "Assistance" was fitted with a Sylvester stove, I believe?—She was.

4278. Did the stove pass through your cabin?—Yes.

4279. Did it admit heated air into your cabin?—It did not open into my cabin.

4280. Did it open anywhere on the lower deck?—It opened into the captain's cabin abaft, and the fore part of the lower deck.

4281. Did you observe a marked difference in the condition of the ventilation of the lower deck in consequence of the improvement which you made in the passage from the lower deck to the upper deck?—Very decided.

4282. Was there less drift?—Much less drift.

4283. Did that condensation on the lower side of the upper deck ever freeze on the beams and become white?—Frequently, especially where there was an iron bolt.

4284. Was your upper deck covered with snow?—Yes; snow and gravel.

4285. Did the men suffer from this condensation

dropping upon them after they had gone to sleep in their hammocks?—Yes.

4286. Did you suffer from it in your cabin ever?—The ice used to form along the sides of my cabin, and occasionally thaw and run down the sides. I had no drip from overhead on to my bed, that I can recollect.

4287. You had no signs of scurvy whatsoever, I believe, on board the "Assistance"?—We had some signs, but no positive case of scurvy. During the time that I was in the "Assistance" no case was put in the sick list as scurvy, I think.

4288. Here is a scale of diet arranged by the Arctic Committee (*handing the same to the witness*). Will you cast your eyes over it, and explain to the Committee whether it is similar to the one which you had on board the "Assistance"?—It is similar to that. The scale of victualling on board the "Assistance" varied occasionally; the captain sometimes gave a little more than at other times; he varied the quantities occasionally. We were not on exactly the same scale of victualling the whole time.

4289. But in your opinion that scale, with the slight modification which you have mentioned of an occasional increase, is sufficient to maintain men in good health throughout an arctic winter?—That is my opinion.

4290. Did your men on board the "Assistance" take their lime juice regularly?—To the best of my belief, it was served out to the messes.

4291. Not to each man?—No officer was specially appointed to see the men take it.

4292. That is to say, it was taken from the tub the same as the grog?—Yes.

4293. Do you think that all your men took it?—I had no reason to suspect that they did not.

4294. You said you had a slight symptom of scurvy; would you connect that in any way with those particular men not drinking their allowance of lime juice?—No, I did not suspect that.

4295. I have here the dietary of Captain Nares for sledge journeys (*handing the same to the witness*); will you look over it and tell the Committee whether, with your experience, there is anything that you would have added to that?—In our expedition there was a quarter of an ounce of lemon juice in addition to this scale; a quarter of an ounce per man per day.

4296. Would you recommend that to be taken on sledge journeys?—I should recommend the lime juice to be taken, but in the early part of the season there appeared great difficulty in using it.

4297. Did you take it on all the sledging expeditions on which you were away with Sir Edward Belcher?—I have no doubt we did, but (it may appear strange) I have no recollection of it. I have no doubt we must have taken it, but I do not recollect ever seeing it whilst we were travelling.

4298. Or ever partaking of it yourself?—No.

4299. (*Admiral Inglefield.*) Did the men in the expedition in which you were engaged take their lime juice, summer and winter?—Yes, on board the ship.

4300. Was it issued on the quarterdeck, or carried below?—It was issued on the quarterdeck, and carried below.

4301. You have every reason to believe it was all drunk?—Yes.

4302. You never heard of an exception?—I never knew of an exception, unless it may have been amongst officers.

4303. Do you consider the lime juice deteriorated in the arctic regions?—I cannot say that it does.

4304. With reference to carrying lime juice on your sledges, what measures were taken? I think you said you were away with Sir Edward Belcher on one occasion; how was the lime juice carried then?—In a tin can, I believe.

4305. And how issued?—I have no recollection of its being issued at all in sledge travelling.

4306. Do you place great confidence in the use of lime juice as an antiscorbutic?—It is useful as an antiscorbutic. I do not think that it will prevent scurvy altogether.

4307. If you were engaged now on an arctic expe-

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dition, and in command of a sledge party, what would you consider as an imperative diet to prevent the symptoms of scurvy?—I should now think it was necessary to carry either a liberal allowance of vegetables or a larger quantity of lime juice even than was in our sledge dietary.

4308. We have had it in evidence that one medical officer, who was on a sledging journey, used to take the frozen lime juice and melt it in his mouth, and the men did the same, the quantity being about a quarter of an ounce per diem. To that he attributed great benefit, and by adopting such a process it was unnecessary to carry fuel for melting the lime juice. Do you think that is a method in which it might be safely utilised?—I should have thought that the undiluted lime juice would have been injurious to the mucous coat of the stomach. I should have been afraid to give it undiluted.

4309. But he assured us positively that he did it himself, and that the men with him did the same, and that they derived no disadvantage, but found it rather palatable than otherwise, and it quenched their thirst. Do you think that lime juice might be carried in small capsules and, thus thawed, either mixed with tea or taken with their rations in some other form?—Possibly.

4310. The reason I ask this is because the condition which necessitated their not carrying lime juice on the northern sledge journeys was the quantity of fuel that they would be required to take for the purpose of thawing the water with which it must be mixed. Now, if lime juice could be carried in such a form as to obviate the necessity of thawing water for mixing with it, it seems that that difficulty which has been suggested in the late expedition would be obviated?—No doubt it would.

4311. Then do you think it might be carried in a capsule or in a small bladder, and each man take his own allowance?—I do not see any objection to that.

4312. With reference to tea and rum, to which do you give the preference, and how would you have it administered to the men?—I think they are both good in their way. I believe rum was useful in our sledge journeys.

4313. But would you give the preference to the rum or to the tea for the midday meal?—I would give the preference to the tea for the midday meal, and the rum at night. It takes longer to make the tea, that is the only objection, and a long halt in the middle of the day is objectionable.

4314. But still the long halt in the middle of the day would be better than a halt at night for the purpose, if they were travelling at night, would it not?—When they halt at night they pitch their tent.

4315. Has the acclimatisation of the men occupied your thoughts at all; do you think men can be acclimatised to the rigours of an arctic winter?—No; I have always thought that the longer men remained in the arctic regions the weaker they became.

4316. Have you formed any opinion as to the best age for men engaged in arctic service?—I should say from about 24 to 34.

4317. Did you find much game in Wellington Channel?—No.

4318. Sorrel or scurvy-grass?—None.

4319. Did you grow mustard and cress?—We did as much as we could, but the quantity was very small.

4320. What was the condition of your men when they came down to Beechey Island, before I brought them home?—Many of them had scorbutic taint, among the men.

4321. You think that if they had remained another winter there would probably have been a great deal of scurvy in your ships?—I have no doubt there would have been.

4322. But for the first winter and season they were comparatively free?—Yes.

4323. Now to what do you attribute that, bearing in mind the extraordinary outbreak of scurvy upon the recent arctic expedition?—I do not know the con-

ditions under which the ships in the recent expedition were exactly. I cannot account for the difference there was.

4324. Briefly, the conditions were these: that they experienced a much longer winter, and a greater extreme of cold, and were subjected to very severe work in their northern journey, otherwise the conditions of both expeditions were similar; the ships fitted with the same care; provisions very similar; men selected with the same attention; and, therefore, the conditions of the two expeditions at starting were very similar?—I should consider that the long absence of light and the greater degree of cold they had, had something to do with it. Possibly their decks may not have been so dry even as ours were. I do not know what exercise they had. Our lower deck used to be cleared twice a day, forenoon and afternoon; the men used to be sent out for a couple of hours or so in the forenoon, and the same in the afternoon.

4325. We can show you the daily routines of the two ships, which will give you an idea of how the men were occupied. (*The same were handed to the witness.*)—I consider these routines very similar to those of the expedition in which I was engaged.

4326. Do you consider that there is any advantage in a Sylvester stove over one where hot water is used for heating the decks?—The Sylvester stove requires a large quantity of coal; it would be very effective if you had a sufficient quantity of coal.

4327. Then coal being no object, you would prefer a Sylvester stove to an ordinary hot water apparatus?—I should.

4328. Do you consider the use of tobacco advantageous or otherwise?—Advantageous, in moderation.

4329. Have you ever heard of the Esquimaux having scurvy?—I have.

4330. Where? in the Greenland settlements?—In the Greenland settlements. I do not recollect the date or the particulars, but my impression is that they have had scurvy.

4331. And do you not at all know what their remedies are when attacked?—No.

4332. Have you any suggestions which you can make with reference to the object of the present enquiry, which have not been elicited from you by the questions which have been already put?—I do not think I have anything to suggest.

4333. (*Dr. Fraser.*) You have been engaged in expeditions in the neighbourhood of both Poles, I understand?—I have.

4334. Had you much sledge work when at the antarctic regions?—None.

4335. Had you any scurvy?—None.

4336. Your experience of scurvy is limited to your expedition in the arctic regions?—Yes.

4337. There you had several I think four-sledge expeditions?—Four or more.

4338. Can you remember which was the longest of these expeditions?—The one with Sir Edward Belcher to the north-east; we were away 28 days.

4339. And the next longest?—Twenty-four days.

4340. Which one was that?—The south-west division of sledges, under Commander Richards.

4341. Had you any other expeditions with sledges of considerable length?—I was 17 days away on another occasion.

4342. Were these generally dog or man-sledges?—Man-sledges entirely.

4343. Were there any special difficulties encountered in these expeditions?—Occasionally the ice was very rough and the work was very heavy. At other times it was smooth, and we could go along for miles without a check. In the latest season, when the ice began to get thin and get covered with melting snow, it was often very difficult and very trying to the men.

4344. Was the scurvy to which you have referred restricted to the ship on these expeditions?—It was not restricted to either; there were some slight cases of scurvy which occurred during the absence of one or two of the sledges, but in one case, at all events,

they recovered in a great measure before they came back to the ship.

4345. The board ship dietary was very much the same as that which you have been shown?—Very much the same.

4346. Can you enumerate the vegetables comprised under the headings of preserved and compressed vegetables?—In the expedition that I was in, we had carrots preserved in tins, parsnips, beetroot, potato in two forms, cabbage compressed, and mixed vegetables comprising cabbage and carrots and other vegetables mixed and pressed together in a cake.

4347. There were two forms of potato, I think you have told us; what were they?—One was Edwards's preserved potato, and the other was a French preparation by Chollet, I think; thin slices of potato dried.

4348. Which do you prefer?—Edwards's preserved potato.

4349. Did you carry in the sledge parties the same quantities of potatoes as in the scale for sledge parties that has just been shown to you; you will find that the quantity there is two ounces?—I do not think that we had more than an ounce a-day.

4350. Had you any other vegetable in the sledge parties?—No; none.

4351. Merely one ounce of preserved potatoes?—I think so, but I am not certain.

4352. You carried lime juice also?—We carried lime juice.

4353. But you are not positive that it was served?—I have no recollection of its being used.

4354. Did you ever yourself use it?—Not in travelling, to the best of my recollection; I have no recollection of doing so.

4355. How many years was that ago?—It was 24 years ago.

4356. You had some cases of scurvy while sledging?—There was one man sent back from the southwest party, who afterwards had undoubted symptoms of scurvy, but at the time that he was sent back it was not put down as scurvy.

4357. Was that case seen by you?—Yes.

4358. Is that the only case within your knowledge?—When Lieutenant Osborn was away, he had a man who had symptoms of scurvy, and he himself had symptoms of it, but they were both much better before they came to the ship, and the man was not put in the list, so far as I am aware, for it. He was in the "Pioneer," not in the same ship that I was.

4359. You do not know, perhaps, how he was treated?—No.

4360. Are these the only cases which you now can remember?—Those are the only cases I remember in the first year.

4361. Any in the subsequent years?—Yes; several cases occurred during the subsequent year.

4362. Were they only during the sledge excursions, or on board ship likewise?—On board the "North Star" I saw several cases, after the crews of the different ships had retreated to her.

4363. Do you know if these cases had occurred in the other ships, or in the "North Star"?—Many of them had been ill in the other ships before they came to the "North Star"; some of them had been ill, and well, and become ill again.

4364. What was the reason of their joining the "North Star"?—Because the other ships were deserted, or about to be deserted.

4365. I suppose extreme privations had been undergone by the crews of the deserted ships, or by some of them?—Considerable exertions had been necessary to get from their own ships to the "North Star"; and very little extra exertion brought out fresh symptoms of scurvy at that period.

4366. Had these men been liberally supplied with food before joining the "North Star"?—Yes, they had a fair allowance.

4367. There had been no scarcity?—No.

4368. But I dare say you cannot tell us particularly what their dietary had been, can you?—The men who came from the "Resolute," including, of course, the

crew of the "Investigator," which had before that retreated to the "Resolute," had had, in addition to their ship's diet, fresh meat occasionally, musk oxen or deer; the men of the "Assistance" and the "Pioneer" had no fresh meat, or almost none. The Christmas of 1854 we had a dinner of some birds that had been brought by the "Phoenix" to Beechey Island and sent up to us.

4369. You do not know, do you, whether in these ships the supply of preserved or fresh vegetables, or of lime juice, had been liberal?—It was the same in all the ships.

4370. And, in your opinion, was it liberal?—Yes; the "Investigator" was short of provisions, but I am not aware that any of the others were.

4371. Do you recollect having ever required to thaw lime juice before it was issued in sledging parties?—I do not recollect ever seeing it used in sledging parties.

4372. Then, in this respect, is your experience restricted to the sledging parties of the "Assistance," or does it extend to the other ships?—It is restricted to the sledging parties of the "Assistance."

4373. Can you give us a general idea of the cubic space allowed to the men on board such ships?—No, I do not know.

4374. At any rate, so far as you can recollect, the condition of the purity of the air in the sleeping compartments was satisfactory?—Not altogether satisfactory; it might have been better, of course.

4375. But your opinion is chiefly founded, I presume, on the offensiveness or non-offensiveness of the air to the organs of smell, is that so?—Yes.

4376. You do not found any opinion on analysis?—No.

4377. You think that in the recent arctic expedition scurvy is, to some extent at any rate, to be attributed to the long absence of light, to the damp, to the great cold, and probably to the hard work experienced?—I think so.

4378. These are not conditions invariably antecedent to outbreaks of scurvy, are they?—No.

4379. Scurvy may occur in the absence of any or all of them, may it not?—Yes.

4380. And there must, probably, have been some further cause besides these general causes to account for this outbreak, must there not?—Very likely.

4381. You are not able to give any opinion as to this further cause?—No.

4382. I see from a printed paper that you were one of the gentlemen consulted by the Arctic Committee in reference to the equipment of the last expedition, is that so?—Yes; I was connected with the Arctic Committee.

4383. You were consulted chiefly, I think, on the subject of stores, provisions, and clothing; is that so?—Yes.

4384. Only on those subjects?—Only on those subjects.

4385. Your opinion was no doubt asked in reference to the scale of dietary in that case?—It was.

4386. And is this scale of dietary in accordance with your views?—Yes.

4387. Do you recollect now on what principle you proceeded in drawing up this scale?—We took the scales of former expeditions, of Admiral Austin's and of Sir Edward Belcher's chiefly, as a guide.

4388. It was founded upon previous experience?—Yes.

4389. Was there any reduction made of the substances contained in it to their food elements, or to their elementary composition, and any calculation made therefrom of the sufficiency of the scale?—There was no reduction made.

4390. Did it occur to you that condensed milk might have been a useful addition to the store of provisions?—There was some milk, I think, was there not, in the medical comforts?

4391. But I mean as a daily article of diet?—There was milk along with the chocolate supplied to the sledging parties.

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4392. Is there milk in the chocolate represented in this scale of victualling marked here as one ounce of chocolate; is that milk and chocolate, or chocolate only?—It was Moore's chocolate, especially supplied for the sledges.

4393. Was no provision made for the supply of milk as a daily article of food on board ship?—There was 192 lbs. I see of condensed milk supplied to each ship, not as a daily ration.

4394. And what was its purpose?—To be issued at the discretion of the captain and on the representation of the medical officer.

4395. As a luxury or medical comfort?—As a medical comfort, or in cases where it was considered to be particularly required.

4396. What is your opinion of the advisability of supplying eggs in order to vary the monotony of dietaries such as these are?—My experience of eggs on board ship is, that they do not keep very long. In every ship that I have been in, we have tried taking a large stock of eggs to sea, but they do not keep fit for use very long.

4397. How were they prepared, usually?—In various ways; sometimes smeared over with butter, and sometimes put in lime water.

4398. Then on the whole your experience does not encourage you to advise an issue of eggs?—No, not with the knowledge that I have of the ways of preserving. It is possible that they might be preserved so as to keep much longer than I have seen them keep.

4399. Had the Arctic Committee anything to do with the preparation of the sledge party dietary, or were you personally engaged in giving advice in the preparation of that dietary?—No.

4400. (*Dr. Donnet.*) What was your opinion of the "Alert" and the "Discovery," with respect to their fitness for arctic service, especially as regards ventilation, cubic space, and the system of warming?—The only time that I saw them was a hurried visit that I paid to them in Portsmouth Harbour the day before they sailed. I had no opportunity of examining very minutely, but they appeared to be roomy, comfortable vessels, and, so far as I could judge from appearance, had quite space enough for the crews. I did not measure them, or enquire about that.

4401. I believe that a part of the lower deck of the "Alert" was fitted with hot water pipes; have you any experience of this system, and if so, what is the result of your experience?—I have had no experience of hot water pipes.

4402. In the evidence you have afforded the Committee, I believe you said that the limit of age of men for arctic service should range between 24 and 34?—About that.

4403. Was not the average age of the men of the late expedition much below that which you have mentioned?—I do not know what their ages were.

4404. It has been given in evidence that the majority of the men were about 23; do you consider men of that age able to undergo the hardships of an arctic life?—I should say that men at least two or three years older would be better able to do so.

4405. I believe the question of arctic diet has engaged your attention, from the fact of your having had the examination and supervision of provisions and clothing; did you superintend the coming of the meat supplied to the late expedition?—I did. I watched it during the whole of its preparation. I saw the fresh meat when it came in, and saw it salted. I saw every supply that came in, and I had some of it cooked at the Victualling Yard and tasted it.

4406. Were you then satisfied with it?—Perfectly.

4407. In evidence it was said that the salt meat was much saltier than the meat generally issued to the navy and that many of the men objected to taking it?—It was exactly the same kind of meat that we had in Sir Edward Belcher's expedition; rumps and rounds of the best quality that could be procured in the London market, salted in the ordinary way. The

authorities at the Victualling Yard declared that there was no other way of preparing it with safety.

4408. Have you any opinion of meat cured by sugar?—I have no experience of it.

4409. With your experience, and the experience gained by the late expedition, would you suggest any improvements in the list supplied to sledge parties?—After the occurrences in this recent expedition, I should say that sledge parties ought to have a greater variety, and ought to have more vegetables with them.

4410. Are you able to suggest any particular improvement with regard to this diet?—There is no preserved meat, I see, in this list. I should say that a change to preserved meat occasionally would have a beneficial effect; some men get very tired of pemmican, and can eat preserved meat when they cannot eat pemmican.

4411. What was your individual experience of the preserved meats supplied to the ships; did you consider them insipid?—Rather.

4412. You have had much and varied experience in the arctic and antarctic climates; would you give the Committee your opinion upon the use of alcohol as an article of diet in either of these portions of the globe?—In the antarctic expedition the allowance was a gill of rum a man a-day. I believe that was the service allowance at that time; and the men were preserved in a state of health that is seldom seen on board ship. We went twice from Van Diemen's Land to the antarctic ice, were away five months, and returned without a man upon the sick list; so that I cannot imagine that the rum did them any harm, even if it did them no good. In travelling at night, the men, when cold and exhausted, always looked forward to their glass of rum to warm them. It certainly had a cheering effect upon them at the end of the march, and I cannot say that I saw any ill effects from it. In sledge travelling in the arctic regions, the men always look forward with pleasure to their glass of grog on halting, and they were sometimes so chilled and tired that they were unable to take off their boots until they had drunk it.

4413. Did this halt occur in the middle of the day, or at night?—They had rum twice a day in the expedition I was in; they had rum at lunch, the midday or midnight halt, whichever it might be, according to whether we are travelling by day or by night, and another glass on halting to rest.

4414. Do you think that the men did their work better after taking their spirits than they had done before they halted?—On first starting, after their glass of grog, they appeared to work better, but the effect very soon wore off; but I do not know that even then they were more tired than they would have been if they had not had this glass of grog. Of course, in the second march, after men have been toiling for five hours or so, they cannot work so well as they did in the early part of the day.

4415. If the facilities for making tea were greater, would you not prefer it to an allowance of rum at midday?—Yes, I think so.

4416. I understand you to say that you consider lime juice a valuable antiscorbutic?—Yes.

4417. You state that you cannot give any opinion about the outbreak of scurvy in the late expedition. May I ask you whether you think that if men have taken one ounce of lime juice daily up to the day of sledge travelling, they would be fit and able to ward off an attack of scurvy without being furnished with a further supply of this article?—From the experience of the voyage on which I was engaged, I should say that they might; some of our sledge parties were away for 90 days without breaking down.

4418. Had these parties that were away for 90 days any lime juice with them on their journeys?—So far as I know they did not use it; I believe they left it in dépôt.

4419. Did any symptom of scurvy appear amongst these parties?—Captain Richards' sledge was away the longest; he came back with all his men doing

their work. When they returned to the ship they had swelling at the ankles, and were put on the sick list for a day or two, when they returned to their duty. That swelling I attributed to the work that they had been exposed to before they got back to the ship; they had been wading in melting snow for weeks before they got back, frequently breaking in through the ice, breaking through an upper crust of snow often, and wading up to their knees. I consider that, without calling it scurvy, there was quite sufficient to account for the swelling of their ankles.

4420. May I ask you, for information, whether it is not the general opinion of medical men that the immunity which lime juice gives against an attack of scurvy ceases with the cessation of the issue of this article in long sea voyages?—I believe it is.

4421. If so, does it not become a matter of great moment for men employed on a sledge party to be provided with lime juice?—Yes.

4422. (*The Chairman.*) What was the general character of the ice over which your journeys were performed?—More or less rugged and broken. Here and there along the shores we got what were called leads of smooth ice, that we could travel over perhaps for two or three miles without coming to any difficulty. Then, again, we would come to a place where the ice had been broken and piled up, which we had to clear away with pickaxes and shovels before the sledges could pass through.

4423. What was the depth and character of the snow you encountered?—Generally speaking, the snow was strong enough to bear the sledges. Until the snow began to melt, we could usually walk on it without sinking in more than a few inches. When the snow began to melt, then there were long spells where the men would sink in the snow up to their knees.

4424. That, I presume, was the general character of the snow where it had drifted between the hummocks?—Yes.

4425. Have you read the reports of the sledge journeys performed by the late expedition, and how do they compare in point of difficulty with those performed by you, first, as regards the land journeys, secondly, as to that over the ice to the north?—So far as I can judge from reading those reports, we never experienced such difficulties as they did, or anything, I may say, to compare with them. We comparatively rarely had to double-bank the sledges. We seldom made less than seven miles a day in advance during all the travelling that I had, very often ten miles a day; eight, nine, and sometimes ten miles a day with heavily laden sledges.

4426. In your sledge journeys were any of your men affected by scurvy, or by symptoms which you would now be disposed to consider scorbutic?—Yes, some of them had symptoms which I should be inclined to put down as scorbutic.

4427. To what do you attribute their comparative

immunity from scurvy?—I cannot tell, unless that there was the greatest care taken of them during the winter in every way as to their cleanliness, and the decks being kept as dry as they possibly could be; and they had regular exercise, and were not allowed to remain long on the lower deck, except during the night.

4428. Do you attach any importance to the shorter period of darkness experienced by your people?—I think very likely that made a difference.

4429. (*Dr. Fraser.*) You, I think, have referred to the absence of light as one of the important causes of the outbreak of scurvy in the last expedition, have you not?—Yes.

4430. You know, I dare say, the relative positions of the two ships, the "Alert" and the "Discovery," in their winter quarters?—Yes, I know them.

4431. You were able, perhaps, to form an opinion as to the difference in the duration in the darkness in the one ship and the other?—No; I have not considered that.

4432. Naturally it must be only a matter of a few days, must it not?—It could not be much.

4433. It is, as a matter of fact, only a difference of a few days. Do you know that of the men wintering in the "Discovery," ten appear to have suffered afterwards from scurvy?—No, I am not aware of that.

4434. Assuming that that is the case, do you think that the occurrence of the disease in these ten men was partly to be accounted for by the long absence of light?—I think so.

4435. Are you aware that of the men wintering in the "Alert," about forty-four suffered from scurvy during the travelling?—Yes.

4436. Do you think that one of the causes of the production of the scurvy in these forty-four cases was the long absence of light?—I think so.

4437. Then do you still think that the difference of a few days in the duration of the darkness in the "Alert," as contrasted with its duration in the "Discovery," can account for this enormous difference in the number of cases in the two ships?—No, I cannot think that it would altogether.

4438. Restricting your attention entirely to the outbreak in the recent expedition, with these facts before you, do you think that the absence of light was an important element in the outbreak of scurvy?—I do.

4439. Notwithstanding what you have just heard?—Yes.

4440. And do you think it was a more important element in the case of the "Alert" than in the case of the "Discovery"?—No doubt it was more important, but the difference could not be very great.

4441. Is it your opinion that the difference was so great as to account for the difference in the total number of cases in the two ships?—No, there must have been some other causes operating to cause such a difference.

The witness withdrew.

HENRY PIERS, ESQ., Deputy Inspector-General of Hospitals and Fleets, R.N., *examined.*

4442. (*The Chairman.*) Will you be kind enough to enumerate the arctic expeditions in which you were engaged?—I was only in one with Sir Robert McClure in the "Investigator." We were commissioned, I think, in November, 1849, and paid off in October or November, 1854. We arrived in October, but I think we were not paid off until nearly a month afterwards.

4443. Will you enumerate the sledge journeys in which you were engaged?—Only in a sledge journey from Mercy Bay to Dealy Island, about 150 miles.

4444. With the ship's company of the "Investigator," when the ship was left?—Yes, exactly so; and from off Dealy Island to Beechey Island in the following spring, for the purpose of joining the "North Star."

4445. (*Admiral Sir R. Collinson.*) You passed the first winter in Prince of Wales' Straits?—Yes.

4446. And you left there a large depôt of provisions, did you not?—Yes, in the Princess Royal Islands.

4447. What was the scale of victualling during that first winter?—From August, 1850, to October, 1851, it was $\frac{3}{4}$ lb. of meat a day, preserved meat or salt meat, and we had 1 lb. of flour which made $1\frac{1}{4}$ lb. of bread, and 4 oz. of vegetables, besides which, there was $\frac{1}{2}$ lb. of flour three times in a fortnight; chocolate, sugar, peas, pickles, cranberries, and soup twice a fortnight, $\frac{3}{4}$ lb.

4448. Were your men on that diet throughout the whole of the first winter?—Yes.

4449. And did you think that was sufficient to maintain them in good health?—They were in very good health.

4450. At the termination of the first winter, on that

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diet, your crew you considered in a good condition?—Yes; I do not say that they could not have eaten more; they would have liked more, but still they maintained a good state of health.

4451. Would you advise their having been given more?—I would certainly.

4452. You think that it was hardly a ration sufficient for a man for an arctic winter?—I think not.

4453. Will you tell the Committee in what way you would increase it?—I would give more meat in the first place.

4454. Would you say what quantity? I do not think $1\frac{1}{2}$ lb. of preserved meat or salt meat too much; salt meat shrinks very much.

4455. You think that $1\frac{1}{2}$ lb. of meat should be served to those who are employed on arctic service?—Yes, I think so.

4456. To continue the diet question; the second year in Mercy Bay, what was your diet?—On the 1st of October we were put on two-thirds allowance, that is, $\frac{1}{2}$ lb. of meat and $\frac{2}{3}$ lb. of flour for bread.

4457. Had that any effect upon your people?—I think a decided effect.

4458. So that at the end of the second winter, your men had, in your opinion, suffered from want of sufficient food?—I think so.

4459. Did you get a considerable quantity of fresh food the second winter?—We got more the second winter.

4460. In what proportion was that issued?—I am not certain. I have no record, but I think it was served out at a pound a day, whether deer or any other game.

4461. Could you refer to your journal on this point?—I could not. I have been referring to it for details, but I only received a letter from the Committee on Friday, and had not sufficient time to go through it. I have looked at certain parts of my journal.

4462. Is it your impression that the reduction of food was in a great measure the cause of the state of health of the men at the termination of the second winter being not so good as it was at the end of the first?—Certainly.

4463. After the first winter your men had a considerable amount of sledging, had they not?—Yes.

4464. And when the sledging parties returned to you what was the condition of the men, generally speaking?—I think very good; there were a few cases of frost-bite.

4465. Had you any cases of scurvy?—Not one.

4466. After the second winter you had not much sledging, I think?—No; I think the only sledging was performed by Sir Robert McClure himself to Melville Island. I think that was the only sledging expedition.

4467. Consequently you had no arduous duty for the ship's company to perform after you got into your winter quarters in October, 1851?—No, not in the way of sledging.

4468. Therefore, from the period of your entering Mercy Bay until the time the ship was abandoned, the ship's company were subject to no arduous labour?—No, they were not.

4469. At the termination of the second winter your ship's company were considerably deteriorated in health, were they not?—Yes.

4470. And were there any scorbutic symptoms among them?—I think in the spring they began to show some signs. I think they were falling off in the beginning of 1852: you could see a falling off in their general appearance and flesh. I think it was about towards the month of May that the first signs of scurvy appeared.

4471. When you abandoned the ship, were there any patients whom it was necessary to carry on the sledges to the "Resolute"?—Yes. We left the ship in two divisions; I was with the first, and we had one man on the sledge and two or three walking.

4472. Were those persons incapable of dragging?—Yes.

4473. Will you state to the Committee what disease

they were suffering from?—The man who was on the sledge had been complaining nearly all the time we were in the ice from one complaint and another; from rheumatism, irritability of bladder and stricture; the whole time we were in the ice nearly he was on and off the sick list, and when we left the ship he was, with a great many others, affected with scurvy; not to any great extent, but still he was like most of the others.

4474. How many days were you crossing over?—sixteen or seventeen, I think.

4475. Had you great difficulty in dragging the sledge?—No; our sledges were light, we had a short journey to make, and then there was the prospect which the men had before them: it was wonderful what they did.

4476. On your arrival on board the "Resolute," did an improvement take place in the condition of the men?—Decidedly, and rapidly.

4477. What do you attribute that to?—To the increase of nourishment, and lime juice, and fruits.

4478. And to the prospect of getting home?—Yes, that had a great deal to do with it. Coming across I know, after being ten days from the ship, on one of our journeys, we dragged, without tenting, for nine and a quarter hours.

4479. You spent the fourth winter on board the "Resolute," did you not?—Yes.

4480. Did you spend the winter of 1850-51 at Princess Royal Island; 1851-52 at Mercy Bay; 1852-53 at Mercy Bay, and 1853-54 on board the "Resolute"?—Yes; we left Mercy Bay in 1853.

4481. During the second winter spent in Mercy Bay, and the third of your expedition, was the allowance of provisions increased?—No; it was reduced further.

4482. Can you give the Committee the diet of the second winter spent in Mercy Bay?—There was a reduction of vegetables from 4 oz. to $2\frac{1}{2}$ oz.; there was no reduction of meat or bread; cocoa, $\frac{2}{3}$ oz.; tea, two-thirds of a $\frac{1}{4}$ oz.; lime juice, which was the principal thing, was $\frac{1}{2}$ oz. daily, a table spoonful.

4483. On your arrival on board the "Resolute," you were placed on full rations, were you not?—Yes.

4484. And that, together with the relief of the men from the position in which they were, had a great effect on their health?—Yes, certainly. Of course they had a liberal allowance of lime juice on board the "Resolute." A great many of them went on the sick list.

4485. Would you describe to the Committee the condition of the men of the "Investigator" during the winter that they spent on board the "Resolute," the number of men generally upon the sick list, and the principal disease which they were suffering from?—I do not know whether my memory serves me so well as that. I know that, at first, when we went across, a large number were placed upon the sick list; but they gradually dropped off through the winter, till there were only a few of our men on the sick list.

4486. Did any deaths occur after your arrival on board the "Resolute"?—Two.

4487. But the other men recovered?—Yes, to a wonderful degree.

4488. When you had left the "Resolute," and got down to Beechey Island, what was the general condition of the crew of the "Investigator"?—It was very much better; very greatly improved to what it was after the third winter.

4489. The effect of the provisions undoubtedly told upon your ship's crew?—Undoubtedly, and also the prospect of getting home, there is no doubt, had a very salutary effect upon the minds of the men, and upon the body through the mind.

4490. I would like to recur for a short time to the ventilation on board the "Investigator"; will you describe to the Committee what steps were taken to introduce fresh air to the lower deck during the winter, and to keep the lower deck dry?—We had the Sylvester stove, and we had metal ventilators. I have forgotten whose they were, now; there were three or

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four in the ship that went through the deck, and through the awning.

4491. There were uptakes, then?—Yes, uptakes.

4492. Had you any downtakes?—I do not think so, except by the hatchways.

4493. Then all the fresh air that was admitted on to the lower deck came down the hatchways?—Yes; I think so, so far as I remember. I do not think there was any other.

4494. Had you much drip from the lower part of the upper deck from the beams?—Yes, sometimes; we were constantly wiping them.

4495. Did it ever freeze?—Yes; and in the cabins I have seen it also.

4496. Were the men's blankets wet with it when they were sleeping?—No; I do not think the blankets were wet; I do not think it was to that extent.

4497. Did you ever suffer in your own bed from water dripping upon you from the beam?—No, I did not. My cabin was in the ward-room, and it was dry; but some of the officers' cabins, on the opposite side, outside the ward-room, and opposite the gangway, were not; when they lighted their candles, I saw the moisture dropping.

4498. Can you recollect whether the air from the Sylvester stove was admitted into your cabin from the tubes in which it was placed, or whether it was closed? did you get hot air from the Sylvester stove, or did you get warmth? was there an opening into the cabin?—No.

4499. Therefore, all the warmth that you got was from the tube itself?—Exactly.

4500. And no fresh air?—No fresh hot air from the stove.

4501. Was the communication of the men with the upper deck by the fore hatchway or the main hatchway during the winter?—I have an idea that we had only one hatchway.

4502. Was that hatchway near to the galley, or was it just before the mainmast?—I cannot recollect.

4503. Was there any house built over that hatchway, whereby you communicated with the upper deck?—Yes.

4504. So that the men, after coming up the ladder, came into an apartment separated by a door from the upper deck, where an awning was put?—As you got up the ladder, the door was immediately to your hand. There was no cabin, as it were, around.

4505. Therefore you entered directly from the lower deck on to the upper deck?—Yes; there was a door at the top.

4506. Had you two doors, or only one?—It is a long time ago to remember these things, for it is nearly a quarter of a century ago; but I think there was only one door.

4507. Your men on board the "Investigator" had the usual allowance of lime juice, had they not, until the small quantity on board compelled you to reduce the allowance?—That was in October, 1852.

4508. Was that reduction of lime juice in your opinion conducive to the weakness of the crew in the following year?—I think there is no doubt of it.

4509. Combined with the small ration of provisions?—Yes.

4510. From the answers which you have given me, you are of opinion that, if, a larger ration of provisions could have been given to the crew of the "Investigator," they would have been able to go through the third winter with less disease than occurred to them?—Certainly.

4511. (*Admiral Inglefield.*) During the time that you were in the "Investigator," was lime juice given regularly, as long as it would last, to the men, and issued on the quarterdeck, and were they seen to take it?—They were seen to take it. I cannot say that it was issued on the quarterdeck; I am not certain about that.

4512. I mean issued on the main deck, or somewhere, so that they were made to drink it at the tub?—I have no question on that point.

4513. Whenever sledging journeys were sent away

from the ship, were they supplied with lime juice?—I think not, they had citric acid.

4514. In what form was it supplied?—In crystals.

4515. In those days was that considered a substitute for lime juice?—I do not know; I should regard it as very inferior to lime juice. I do not say that it possesses no antiscorbutic property, but I should say it was very inferior to lime juice.

4516. Nevertheless it was supplied to the expedition as an antiscorbutic?—It was; but the citric acid was a medical article, not a general ship's store.

4517. In what form was it supplied?—In a crystalline form.

4518. Then it could be carried easily on sledges without the necessity of thawing or mixing with water?—It required mixing with water, of course, to be dissolved.

4519. What proportion had you of it compared to lime juice?—A very small proportion.

4520. Why was it supplied you instead of lime juice?—I am not prepared to state the reason why, I only know of the fact.

4521. Then I gather from you that it was supplied as a sort of supplement to the lime juice?—No, as a substitute.

4522. But supplementary to the lime juice?—There was no lime juice on the sledges, so far as I recollect. There may have been so, I will not say positively there was not.

4523. But citric acid was sent with the sledges?—Yes, and my impression is that there was no lime juice, but I cannot speak positively.

4524. How many men died altogether during the four years you were in the "Investigator"?—One officer and four men died.

4525. Who was the officer?—Mr. Sainsbury, a mate.

4526. What year was he there?—He died on board the "Resolute," in November, 1853.

4527. You have described to the Committee what extraordinary physical effect upon the men their being received on board the "Resolute" had, and I think you ascribe it to the mental impressions?—Yes, to the prospect of getting home, with the improved diet, of course.

4528. Then it is clear, under these circumstances, that you attribute a good deal of the physical condition of the men in those regions to their mental conditions?—Yes; it is a great thing, I think, to keep them hopeful.

4529. Then may I gather that when an abundance of food is supplied of the proper description, and there is no prospect of failure in the enterprise, or other misfortune, you do not consider that the length of time in the arctic regions would seriously affect the general constitution of a man?—If you can afford the men a sufficient supply of animal food and vegetables, I would not say how long they might maintain their health there.

4530. In fact, where the body is well supported, and the action of the mind is not extra, and the strain great, men may live comfortably there, and in health?—Yes, I think so. I would not say how long.

4531. That is the result of your experience in the "Investigator," which was in about as hopeless a condition, I suppose, as any ship was ever placed in?—Yes.

4532. Have you formed any opinion as to the proper age of the men for arctic service?—I think the younger the better; when I say young, I think perhaps not under 21 or 22.

4533. Up to what age?—A man's experience is to be taken somewhat into account. A man for a first voyage, I should say from between 21 to 30 would be the best age.

4534. Do you think that, if a whole ship's company were formed of men of the age of 20, or a little over, their constitutions would be sufficiently formed to meet all the vicissitudes of arctic service?—I would not say all, but you will find some men of 20 and 21

H. Piers, Esq., quite fitted for it; and so there are some men that you might take over 30, up to 35.

4535. Have you ever heard of the Esquimaux having scurvy?—I have not, but I should not wonder at their having it sometimes.

4536. With reference to the use of tea and rum, to which do you give a decided preference?—To tea, decidedly.

4537. How would you propose that it should be always given to the men; at what time of the day, or during what part of the journey, speaking now especially with regard to sledge journeys?—I should not like too much tea; I should prefer cocoa. I should say tea and cocoa both.

4538. Has cocoa such an invigorating and cheering effect as tea?—I do not know that it is so cheering, but it supplies so much nutriment and warmth.

4539. You obtained a good deal of game, did you not, in the winter quarters of the "Investigator"?—Yes; the second winter, and also some the third winter.

4540. What did it consist of?—Very few musk oxen; we only got two in the two years that we were there; it was chiefly reindeer, hares, and ptarmigan.

4541. Did you obtain scurvy-grass and sorrel?—Very little scurvy-grass, but a great deal of sorrel.

4542. Were you able to grow mustard and cress in any quantities?—We did for some time, but it dropped; there was not a great deal of mustard and cress grown.

4543. Amongst the ship's company of the "Investigator" I find there were some men who were more temperate in their habits than other men; did you remark any difference in their ability to withstand the rigours of the arctic climate?—I think the teetotallers rather had the advantage. I can instance one person who stood more cold and did more hard work than any man that I knew of in all the expeditions out there, and he was a teetotaller; that was Mr. Court, the master.

4544. Was he the master of the "Investigator"?—Yes.

4545. You state that being a teetotaller he performed more hard work and withstood the cold better than any person that you knew out there?—Yes; I can mention one thing about him: I was out with him at one time shooting, and I saw him loading his gun with bare fingers at a temperature of 60° below zero.

4546. Touching metal at that point would be like touching hot iron?—I would not be positive about that temperature. I would not like to say exactly what it was without referring to my journal, but it was something very low, I know. His cabin was opposite the gangway, and sometimes it would be open, when I have seen it covered with ice; and I know that regularly he used to get up at four o'clock in the morning and write in his cabin. I never knew such an instance of power to endure cold.

4547. He must have had a very quick circulation of blood, and there was something in his physical condition which was different to most men?—It must have been so.

4548. You never had him as a patient, I suppose?—Never. He was very active both in mind and body. He is now dead.

4549. You remember that there was one officer who went out of his mind, and was brought home in my ship, Lieutenant Wynniatt?—Yes.

4550. Was that brought on by the peculiar action of the temperature, or by depression of spirits engendered by the long voyage?—I think it was the effect of the voyage on his mind; but he was pre-disposed to it, because he had talked to me upon the subject before the disease manifested itself.

4551. Had you any other cases of monomania?—We had one man who was imbecile of mind.

4552. Was that brought on, do you think, by the effects of the climate?—Yes, and of insufficient food.

4553. If you had to suggest a scale of diet for a

sledge party, under either ordinary or extraordinary circumstances, would you insist upon a lime juice ration?—I should like it.

4554. But you would not insist upon it as a necessity, judging from your personal experience and your knowledge of the failure of the last expedition?—I have generally thought that if men were brought up properly to the sledge ropes, that is to say, well prepared for two or three months beforehand, they would go through a considerable journey without manifesting scurvy. It certainly would be an advantage if they could take lime juice. I would not say how long they might go without it, if they were well fed, and had plenty of lime juice beforehand.

4555. From what you have read with reference to the late expedition, and from your own experience in past years, have you any suggestion which you can offer to the Committee with regard to the present enquiry?—I think that everything is known almost with regard to scurvy, and what is best for it as a preventive and as a remedy, and I do not know much more than one can suggest. I think it would be well if they could do away with salt meat, and could provide some other instead.

4556. That you regard as the principal thing?—Yes.

4557. In fact, you believe that the seeds of scurvy were sown in the men's constitutions before they attempted the sledging journeys?—From all I have read, that is my impression. The cause of the outbreak of scurvy in that expedition is to be sought on board the ships before they went into the sledge ropes.

4558. (*Dr. Fraser.*) Had you any scurvy in the two sledge expeditions in which you took part?—In the first the whole party, or nearly the whole, were more or less affected, but not to any severe extent.

4559. That was in the expedition from Mercy Bay to Dealy Island?—Yes.

4560. Nearly every man was affected?—The greater portion of them.

4561. What kind of sledge was it, was it a dog or man-sledge?—A man-sledge; we had no dogs.

4562. What was the number of the party, including officers?—The party in which I was consisted of 3 officers, an interpreter, and 24 men; 28 in all.

4563. What were the scorbutic symptoms with which they were affected?—We could not see it perhaps so well ourselves as others could, but there was a peculiar expression of countenance in the first place, in fact, they said when we got to the "Resolute" that we all looked insane.

4564. Your sledge party was not so dirty that the peculiar expression of countenance could not be distinguished?—No. The gums were spongy and bleeding, and some of them had a fungus-like appearance; and the legs of some of the men were swollen, oedematous, and in some instances there were petechiæ.

4565. Did the teeth fall out at all?—No, it was not so bad as for the teeth to fall out.

4566. Was there any hæmorrhage?—None in that expedition.

4567. Did you notice if flying pains were among the early symptoms in the sledging expedition?—We were affected with them before we left the ship. We were just crossing the strait, at the end of the third winter.

4568. Those two sledge journeys were made subsequently to the abandonment of the "Investigator," were they?—Yes, on the abandonment of her.

4569. And previously to that time you had had scurvy on board that ship?—Yes.

4570. But you yourself were not connected with any sledge journeys made from that ship previously to her abandonment, were you?—No. I had been away from the ship, I think, two or three times, perhaps for ten days or a fortnight, shooting game on the land, in tents.

4571. Were any sledging parties sent from the "Investigator," before her abandonment, for any long

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ourney?—I think the longest journey was about a little over 40 days.

4572. In what year was this?—That was in the spring of 1851, after the first winter there.

4573. Then you had scurvy on board the ship previously to sending away this expedition?—No, no signs of it.

4574. Do you recollect what scale of victualling was used by the sledge party?—I have not the scale of victualling with me.

4575. Perhaps you can remember if any vegetable food was carried, and, if so, what?—I think the only vegetable food was biscuit and oatmeal; no potato. Our ship was very different to all later expeditions.

4576. (*Admiral Sir R. Collinson.*) Had you not preserved potato?—Not in the travelling expedition. I would mention that, when Sir Robert M'Clure went away for ten days in October, after we got into winter quarters, in those ten days eight persons consumed only between 50 and 60 lbs. of solid food. We never had sufficient fuel for cooking in our expeditions.

4577. (*Dr. Fraser.*) Returning to the sledge expedition in the spring of 1851, which lasted 40 days, was the health of the men good throughout the expedition?—Yes, from that one the men all returned well, so far as I remember; that was Lieutenant Haswell's expedition.

4578. Did they carry lime juice?—My impression is, that they did not carry lime juice in our travelling parties.

4579. In none of your sledging parties?—That is my impression. I cannot state it as a fact.

4580. What substitute was carried for lime juice?—Citric acid.

4581. Can you remember what doses of citric acid were considered proper daily rations?—I cannot. I do not think there was any special dose. I have no remembrance of any special dose being prescribed. I think that the men took it as a drink with water, it was there for their use as a drink.

4582. Had you any other sledge expeditions in 1851 besides this one?—Yes; there were two others.

4583. And was citric acid carried in both of them?—That is my impression.

4584. You cannot, perhaps, remember the dietary in those other two expeditions?—No; but I have a note on Captain M'Clure's short journey in October, 1850. The note is dated October 31st, and runs thus: "The men on their return looked very thin, and some of them much exhausted, which will not be wondered at when the fact is recollected, that these eight people, travelling for ten days in the arctic regions at this late season of the year, ate only 57 lbs. of solid food. The reason for this small consumption of food was, that they took so small an allowance of spirits of wine for fuel that they could not afford more than five gills of fluid a day, for each person." Then, it says, "had nothing warm, except cocoa, which never boiled."

4585. As you did not yourself accompany those sledging expeditions, you cannot, of course, give us any definite information respecting the use of the citric acid?—No, I cannot; I might say that none of the men returning from those expeditions showed any signs of scurvy.

4586. That is in the expeditions of 1851, you mean?—Yes.

4587. Do you know if they would have any opportunity of getting fresh vegetables while travelling?—None whatever.

4588. Assuming that those dietaries did not contain any fresh vegetables, assuming also that the men were unable to obtain any fresh vegetables growing in the ground, and assuming also that the citric acid carried was really consumed, the result of the sledging parties, so far as the health of the men was concerned, being that no scorbutic symptoms were manifested; what is your opinion of the value of the citric acid, there being apparently no other antiscorbutic carried by the men?—I am disposed to attribute their return in good health rather to the

condition in which they started upon the sledging journey. I will not say that the citric acid had not been of use, but I attribute more to the condition of the men on starting.

4589. Do you think that that condition would be maintained, notwithstanding the absence of an efficient antiscorbutic, for so long a period as 40 days?—The citric acid may have had something to do with it; it is a fact that they did return in good health.

4590. Taking the assumptions which I have stated as granted, what is the inference that you draw with reference to the prophylactic property of citric acid?—I believe it has some prophylactic property. I attribute a part of the immunity from scurvy to that, but I attribute the greater part of it to the state of the men on leaving the ship. I give the citric acid some credit, but I attribute much more to the condition of the men on leaving.

4591. During that year had you any scurvy on board the "Investigator," that is to say, during the year 1851?—No, we had no scurvy in 1851.

4592. You had a tolerably liberal supply of vegetable food, had you not?—I think not; quite the reverse, I should say.

4593. In the scale of dietary which you have given us, you mentioned, did you not, 4 oz. of vegetables daily, as well as cranberries and other fruits?—I do not think I mentioned cranberries. The only fruit we had was cranberries, and that only the first year. My recollection of them is very faint. When it is spoken of as 4 oz. of vegetables, it must be remembered that that is 4 oz. of preserved vegetables, and when our vegetables were reduced to 2 oz., I have known those 2 oz. taken up in a dessert spoon or tea spoon. It was 4 oz. of vegetables nominally, the actual quantity was very different.

4594. I think you did not reduce the quantity of vegetables until the next year?—It was not reduced until the October of 1852.

4595. I am speaking of 1851?—In 1851 we had 4 oz., but the 4 oz. of preserved vegetable, as we had it, and we were obliged to take it as it was supplied to the ship, might not contain more than an ounce and a half of vegetables really. It might be sometimes more and sometimes less, but I know that 2 oz. had been taken up in a dessert spoon, though that was exceptional.

4596. That is while dry, I suppose?—No, it was preserved in tins, in fluid, and the fluid sometimes preponderated.

4597. Then you had not a liberal supply of vegetables during 1851?—No, we had not.

4598. Had you daily rations of lime juice in that year?—Yes.

4599. What was the ration?—An ounce.

4600. So far as you know, was that ration consumed by the whole crew?—I am satisfied it was. That is a point upon which I have no question in my own mind.

4601. You had the ordinary ration of lime juice, a very scanty supply of vegetable food, and no scurvy, you tell us; is that so?—Yes.

4602. When did scurvy first make its appearance in the "Investigator"?—I think it was about the May of 1852 when the first case was noted, but the men had been visibly declining in physical strength and flesh for some three or four months previously.

4603. The crew was now on limited rations, I think?—Yes; from October 1st, 1851.

4604. You have already told us that the health of the men quickly deteriorated after their rations were diminished?—Yes; it was scarcely visible, perhaps, for some two or three months; it did not show immediately.

4605. Had you cases which raised suspicions of scurvy previously to the May of 1852?—So far as you could see, there was some depression of spirits, and loss of flesh. The physical condition of the men you could see was declining some three or four months before the scurvy manifested itself outwardly.

4606. There were no discolourations of the skin

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seen before May, were there?—Not before then; I think it was about May.

4607. Did you find much game in 1852?—Yes, we found a considerable quantity of game in 1851 and 1852.

4608. You mean in the winter of 1851–52?—Yes; in the autumn and spring, and all through the winter of the first year.

4609. In the spring, were you liberally supplied with game?—I would not say liberally, but I daresay it would give us fresh meat perhaps on an average once in ten days, or so.

4610. In the summer, was the supply increased?—I do not know whether there was more in the summer than in the spring and autumn. Perhaps just in the mid-winter we did not get so much.

4611. When the rations were diminished, was the quantity of vegetable food likewise diminished?—Yes.

4612. Was the quantity of lime juice diminished?—No; the lime juice was not diminished, I think, until October, 1852.

4613. Had you many sledge expeditions in 1852?—No; there was only one, and that was to Melville Island.

4614. Was there any scurvy in connection with that expedition?—I do not think so; but I cannot speak positively upon that point.

4615. You yourself did not take part in any sledge expedition that year?—No, I did not, except on leaving the ship.

4616. Did the cases of scurvy increase after the May of 1852?—Yes, they slightly increased.

4617. Can you remember about how many cases you had when the disease was committing its greatest ravages in 1852?—I should think our sick list rarely exceeded 20 out of the full complement of 65.

4618. Had you any deaths that year?—We had no death until April, 1853.

4619. In summer, I presume you had opportunities of obtaining fresh vegetables, had you not?—Sorrel was the only thing that we got to any extent. In the summer of 1852, we got a considerable quantity of sorrel, and the men improved under it.

4620. What is the taste of sorrel?—An agreeable subacid.

4621. Are you inclined to refer any of its antiscorbutic properties to its acidity, or have you had any means of arriving at a conclusion upon that point?—I do not know what to attribute it to, whether to the acid or not; I only know the fact.

4622. Then your cases of scurvy diminished on your obtaining supplies of sorrel, did they, in 1852?—I think that there was a general improvement in the men. I forget as to the actual number of cases diminished on the sick list, but there was an improvement in the men generally.

4623. Was the sorrel used by the whole crew, or simply by those who were sick?—By the whole crew.

4624. Are you not, so far as you can now give an opinion, quite satisfied that the sorrel was able perfectly to check the disease?—I think that if the supply of sorrel had continued for a length of time, we should have got rid of the disease altogether.

4625. How long did it continue?—We had not it for long, I think.

4626. Would you say a month, or two months?—I should think a month was almost the extent of it.

4627. Were your supplies still further diminished in the winter of 1852–53?—Yes, but not the bread or meat: the lime juice was diminished.

4628. What did your ration of lime juice become then?—Half-an-ounce, one table spoonful.

4629. That was one-half the previous ration, I think we have heard?—Yes, just one-half.

4630. Had you much sickness during that winter of 1852–53?—Yes, there was a great deal of sickness that winter.

4631. And what was the predominant illness?—It was a scorbutic taint, showing itself in different ways, and developing diseases to which some were pre-

disposed. One officer broke down with consumption, and one man had disease of the spine, probably scrofulous. I think, whatever the men were predisposed to, those diseases developed themselves under the lowering effect of the conditions to which we were subjected.

4632. Had you decided cases of scurvy, also?—Yes, decided cases.

4633. Were those the symptoms which you have already mentioned?—Yes.

4634. Had you any death that winter from scurvy?—In April three died from diseases associated with scurvy, or induced by it. The three first died in that one month.

4635. Then your largest number of cases occurred about April, 1853?—I cannot say as to the actual month in which the largest number of cases were on the sick list. It was during that winter and spring, I think, we had the largest number; I cannot say to the month.

4636. Can you recollect about what number you had when there were most on the sick list?—I should think about 20; not much over 20, I think.

4637. Had you much good fortune in obtaining game during the winter of 1852–53?—I do not think we got so much, because the men had given up hunting altogether almost that winter.

4638. Why?—From weakness, they could not walk sufficiently. I think that latterly only the officers went out.

4639. You mean that the majority of the ship's company were quite disabled?—I think they were getting disheartened, and they were weak, suffering from scurvy, which was depressing. They were mentally and physically unfitted for hunting.

4640. You say, that they could not hunt because the majority of the crew were suffering from scurvy?—They were suffering from debility; it was not perhaps until spring, that the greater part of them were suffering from scurvy.

4641. And you had so large a sick list that it was impossible to procure larger quantities of game?—If the men off the sick list had been strong enough they might have gone out hunting, but they were disinclined for it; they were in a state of languor, lassitude, and feebleness.

4642. Do you remember if they had pain also?—Many of them had.

4643. These men who were not formally on the sick list, I mean?—I cannot say.

4644. It was usual for the men to have pains?—Yes, pains resembling rheumatic pains. I think (speaking for myself, too) cramp was common.

4645. You yourself suffered?—Yes, I had often cramp in the legs, and also chilblains were general, all signs of debility.

4646. And were you able to obtain sorrel?—Only that one summer, the summer of 1852.

4647. I am talking of the spring of 1853?—We left in April; that was too early for it. Speaking of the winter of 1852 and 1853, and the sick list, I might mention that in the month of December the ship suffered considerably from diarrhoea; it was our coldest month out there, and, I think, as cold as any weather Sir George Nares experienced.

4648. Have you any record of the temperature?—Yes; the mean temperature of the month was -43° ; our lowest was -65° . I think our day's mean was -61° .

4649. What was the total number of deaths that you attribute to scurvy previously to your joining the "Resolute" in this expedition?—I think they might all be attributed to debility and scorbutic taint. The total was three men.

4650. And besides, nearly the whole crew were more or less affected at different times?—Yes, and when they left the ship they were all more or less affected.

4651. They improved rapidly, I think you have told us, after joining the "Resolute"?—Yes.

4652. Do you think you could now tell us what was

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the scale of dietary previously to their joining the "Resolute"; that is, in the same year as they did join the "Resolute"?—That is, our last winter; it is the same as the winter before, excepting that reduction that was made in October, 1852, when there was a reduction of lime juice and vegetables, but not of bread and meat. The bread and meat were the same from October, 1851, to the time we left.

4653. And what was the ration on joining the "Resolute"?—That I cannot tell. I know we had as much as we could eat.

4654. Had you as much vegetable food as you could eat?—Yes; there was plenty of everything on board that ship.

4655. And the cases rapidly recovered?—Yes.

4656. But notwithstanding, one at any rate died, I think, of the original cases?—One man, from a diseased spine, abscess; and Mr. Sainsbury, mate, of consumption.

4657. Now, generally speaking, to what do you attribute the outbreak of scurvy in this expedition that you were connected with?—To a want of vegetable food, and, of course, food in general; primarily, to a want of vegetables.

4658. Do you think that any of the cases might have been avoided, had you been able to maintain the full rations of lime juice?—I am not prepared to say how long we could do with so small an allowance of vegetables and lime juice; but I think that some, perhaps many, of the cases might have been retarded, if not altogether avoided.

4659. I will pass now to the matter of the ventilation of your ship. You were on the whole, I think you have said, satisfied with the ventilation of the ship?—We never suffered in that respect.

4660. Do I understand you, that the downtakes consisted only of the hatchways?—That is all.

4661. Then was there only one downtake?—I think there must have been a second; I cannot recall where it was.

4662. Was there only one downtake for the men's quarters?—Yes.

4663. And the other would be for the officers?—Yes; I think now, if I remember right, the men's was well forward in the ship.

4664. From your description of the Sylvester stove, I gather that it is not a means of introducing fresh heated air, and diffusing it between decks, is it?—No.

4665. Any air that it does diffuse is the air which is already contained in the chamber, not outside air?—The air in the ship; it warms that.

4666. Do you think any advantage would be derived could heated air be diffused throughout the ship as a means of ventilation; I mean, of course, heated fresh air, the source of which is from the outside?—I think it might. I will not be positive about that, whether it was not so.

4667. (*Dr. Donnet.*) Have you made yourself acquainted with the history of the outbreak of scurvy in the late expedition, and have you formed any opinion as to this causes which led to this outbreak?—I have read what has appeared in the papers, nothing more. In the first place, I think the cause must be sought for in the ships, and not in the sledging; and then I think we must look to the lime juice, whether that was good. Assuming the lime juice to be good, then another point is, did the men take the lime juice, I mean in the ships. I have an opinion, from all I have read, that the cause was to be sought for on board the ship, because it appeared ten days after they left.

4668. In the evidence which has been afforded us, it has been stated that the men of the "Alert" took their lime juice regularly?—Did an officer see them take it every day?

4669. It has been so stated?—If the lime juice was good, and the men took it regularly every day, the case is anomalous, and I cannot understand it.

4670. Do you think that lime juice gives an immunity to persons against an attack of scurvy during the period of their taking it, and does this immunity cease with the cessation of the issue of

lime juice?—As a matter of opinion, I should think that the effect of the lime juice would not last long after its discontinuance. I should look more to the general physical condition of the men. Of course, so long as you preserve the health of the men by sufficient and nutritious food, and you maintain the normal condition of the blood by means of lime juice, an immunity from scurvy may be expected; then, on the lime juice ceasing, that condition of blood would not change all at once, but it would gradually become deteriorated.

4671. You are aware that there is a difference between the diet on board the ship and the diet in sledge parties?—Yes.

4672. Do you think that the diet of the sledge parties is sufficient in itself to preserve the condition, which you mention, so as to ward off any outbreak of scurvy in them?—The rations of the sledge parties vary so much; I do not know what their ration was.

4673. That is the sledging dietary of the late expedition (*handing the same to the witness*)?—I should not consider it at all a liberal allowance for a sledging party.

4674. Was there any difference between the provisions supplied to your sledge parties and the provisions in the list that you now have in your hand?—We had not preserved potatoes in our list in the sledging expeditions; we had no bacon; we had no onion powder or curry paste. I think it was a small allowance of vegetables in the list you have given me.

4675. Do you believe that other causes were in operation to produce this outbreak, such, for example, as the absence of light, the great cold, the hard work to which they were subjected, and perhaps the age of the men, the generality of them being young?—As regards the absence of light, I am not disposed to attach much importance to it. I did not find myself, and I do not think any of the ship's company found, the absence of light very depressing. Of course, I do not say that it does not at all operate; all these things do to a certain extent; but not much, I think. I think cold, so far as it tends to lower vitality, favours the development of scurvy, but I do not think any of the above-mentioned are causes. They favour the production of scurvy.

4676. You cannot give any cause for the outbreak of scurvy in the late arctic expedition?—No, I cannot.

4677. I lay before you a scale of victualling which was used on board these ships (*handing the same to the witness*.) Can you offer any suggestion or recommend a larger or a more varied amount of vegetables in the way of preserved fruits or other articles?—I think, speaking generally, the allowance of vegetables and fruits cannot be too liberal. I do not know what vegetables they had, but in the former expeditions they had preserved potatoes, Chollet's and Edwards's potatoes, preserved cabbage dried, and dried apples. The allowance of preserved vegetables given in this list you have handed me, appears to be a fair one. I do not see much fault to find with it, except that I think three quarters of a pound of preserved meat is a small allowance. The great point, I think, is the vegetables.

4678. I believe you were supplied with Edwards's preserved potato in your expedition?—Yes.

4679. Do you attach much value to it, and consider it good?—Very good.

4680. You mentioned citric acid as an article sent with the sledge parties; can you say whether it was so sent as an antiscorbutic?—Yes.

4681. What is your opinion of citric acid as an antiscorbutic?—I think it should be regarded as a very weak one.

4682. Was it used as a curative in scurvy?—Not on board.

4683. Amongst the symptoms of scurvy which you observed were hydrothorax, acites, hydrocele, or other effusions remarked?—Yes, one or two of the cases died.

4684. Besides Mr. Court, who was a total abstainer from spirits, had you other men who were so?—Yes,

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our first lieutenant was a teetotaller, the present Admiral Haswell, and two or three of the men.

4685. Did the men generally care for their rum, and are you able to say that they took it with the same relish during the winter months as during the summer?—I did not remark any difference between summer and winter, but latterly they seemed to care less for their rum.

4686. Do you think that men in arctic service could dispense entirely with this article?—I believe so.

4687. (*The Chairman.*) Assuming that a daily allowance of lime juice could have been administered to the sledge parties of the recent expedition, are you of opinion that the outbreak of scurvy would have been delayed?—Yes, I should say so; that is my opinion.

4688. Are you further of opinion that it might or would have been averted?—Well, on board ship it might, but I am not prepared to say on the ice; because I believe the scurvy was in the men, latent in some form, before they left the ship. It had not manifested itself outwardly. I am not prepared to say that on the ice lime juice would have prevented it altogether.

4689. (*Dr Fraser.*) I should like to have, generally,

your opinion as to why you think the seeds of scurvy were in these men before they left the ship?—I think from what I have read in the papers, scurvy appeared within ten days of their leaving, and also amongst the men who remained on board I think it appeared some ten days after. Taking the sledge parties alone, from the fact of scurvy breaking out amongst the sledge crew or crews ten or eleven days after their leaving the ship, my opinion is that they were scorbutic before they left.

4690. Notwithstanding that they were carefully examined previously to their leaving by the medical officers, and that, as far as we can judge from the accounts of the sledging parties, they did not at first exhibit any symptoms of debility or weakness?—If these men really appeared in sound health, I do not think their blood could have been so vitiated before they left the ship; but, had a scorbutic taint existed, it would have shown itself in some form, in the pulse, or in a failure of strength. I have simply gone upon the fact that these men broke down 10 or 11 days after they left the ship. If they were examined by the medical officers, and they found them in good health and strength, that is a different matter; a new aspect is given to the question, and I am unprepared to express an opinion.

The witness withdrew.

Adjourned to to-morrow at 11 o'clock.

WEDNESDAY, 24TH JANUARY, 1877.

PRESENT :

ADMIRAL SIR JAMES HOPE, G.C.B., in the Chair.

ADMIRAL SIR R. COLLINSON, K.C.B.

VICE-ADMIRAL E. A. INGLEFIELD, C.B., F.R.S.

JAMES J. L. DONNET, ESQ., M.D., Inspector-General of Hospitals and Fleets, R.N.

THOMAS R. FRASER, ESQ., M.D., F.R.S.E.

H. J. VANSITTART NEALE, ESQ., Secretary.

COMMANDER VERNEY LOVETT CAMERON, R.N., C.B., D.C.L., *examined.*

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4691. (*The Chairman.*) What period did your journey through Africa occupy?—It was two years and nine months from the time I left the east coast until I got to Benguela.

4692. During that time did any cases of scurvy come under your notice?—Scurvy broke out just at the end of the journey; I had scurvy myself very bad when I got to the coast.

4693. Amongst whom did it break out?—Amongst some of my men. Two men died, I believe, with scurvy, and the others had swollen legs and were unable to walk, and had to be carried.

4694. (*Dr. Fraser.*) This was, I think I understand you, towards the end of your journey?—Yes, just at the very end. My mouth began to bleed and the spots came on the day before I reached the coast.

4695. After you had been on a journey of two years and nine months?—Yes.

4696. At what season of the year did you reach the coast?—It was in November. I had passed through the beginning of the rains just before in Bihé.

4697. Was it hot or mild weather at that time?—It had been moderate weather. We had been at the high elevation just before reaching the coast of nearly 6,000 feet.

4698. Had you cases of scurvy when you were at this high elevation, or afterwards?—The men showed it at the high elevation.

4699. Had your party been subjected to much privation previously to the outbreak?—From June until we got down to the coast in November, except for

about a fortnight that we were at Bihé we were always marching hard and half starving.

4700. And undoubtedly suffering from privation, I should imagine?—Yes.

4701. When you say you were half-starving, what were you really subsisting upon?—It varied; sometimes one got a goat and sometimes one got a fowl (the usual thing being the native flour), and sometimes sweet potatoes or cassava, and sometimes we cooked ferns and the leaves of the cassava for vegetables. At Bihé, we lived very well for the short time that we were there. The Portuguese had orange-trees growing there, and we got a lot of oranges. I should also mention that at Bihé we all had a fair amount of onions, about a week's supply. After leaving Bihé, just before the scurvy broke out, we were passing through a country which had a good deal of wild fruit, which we were using a great deal just at the time the scurvy first appeared.

4702. Do you remember whether that was before or subsequently to the scurvy appearing?—It was before the scurvy had appeared. At Bihé we got oranges and the other things before there were any apparent symptoms. It broke out when we were going through a country where there was a good deal of wild fruit.

4703. Did it break out in the case of one or two men in the first instance, or was it general, having extended through the party quickly?—We were just over 50 strong, and about 12 or 14 men got it at varying times.

4704. After intervals?—Yes.

4705. Was this the time, during the two years and

nine months, that you were subjected to the greatest privations?—It was during the last part, we were the hardest-pressed in the way of food for a long period; occasionally for a week or so, we had been as bad before, but not for such a long time.

4706. Then your diet consisted, generally speaking, of goat, fowl, flour, fruit, sweet potatoes, and several other vegetable substances?—Yes.

4707. The major part of your food, I suppose, consisted of goat and flour and fruit?—Yes; but we very seldom got a goat.

4708. What did the major part of your food consist of at that time?—Flour made up into dampers; we got but little animal food.

4709. Did you get any large quantity of sweet potatoes just at the time of the occurrence of scurvy?—Just before, but not at the actual time. But just before we had had a good deal at Bihé. At the time it was breaking out, the men all had a large quantity of fruit, sweet potatoes, and things of that sort, which the men had bought on the road. Each man was carrying his own stock of provisions; I had given them cloth to buy their food with for so many days, and they laid it in where it was cheap.

4710. Is the sweet potato a yam?—No; the sweet potato is the yam of a sort of convolvulus; we very seldom got any roots; we got plenty of sweet potatoes.

4711. How is the sweet potato generally eaten?—The natives cook it in all sorts of ways. Sometimes they dry it in the sun and keep it for a long time, and boil it down; at other times they just put it into the fire and roast it; and at other times they boil it in the ordinary way and mix it up with anything they get; any oil,—or meat.

4712. It is a starchy food, is it not?—Yes, it is.

4713. Contrasted, for instance, with the common potato of this country, would you say it was to the same extent a starchy food?—Almost. I should think there is rather more fibre in the root than in the English potato.

4714. It is not more succulent?—No.

4715. Is it as succulent?—Yes, I think about the same.

4716. You had no milk, had you, at the time?—No. I got milk three days before I came to the Coast. I got a little sour milk at a place called Kisanji.

4717. Did the supply of sweet potato continue for any time after the appearance of the first cases of scurvy in your party?—We were getting so close to the Coast then that after it first broke out we were at the coast within three weeks. I picked out some of my best men and took them on with me, and sent back limes and food from the coast to meet the others for the sick, and they came on more slowly. I came down the last 120 miles in four days.

4718. You had altogether 12 or 15 cases out of 50 of your men?—As nearly as I can tell about 12 or 15 out of 50. It varied in intensity; some of the men had to be carried; others were able to walk, and two men died.

4719. They were natives, were they?—The most of them were freed slaves from Zanzibar, a mixture of all tribes who are exported to Zanzibar.

4720. About what complexion of skin were these men?—They were nearly all very dark.

4721. You noticed feebleness, did you not, amongst the early symptoms?—Yes.

4722. Can you recollect what other early symptoms you observed?—In my own case, not knowing exactly what was coming on me, I remember finding some old bruises paining me, and a sprained ankle, which I had sprained about four or five months before, began to give me pain again.

4723. In the natives, what symptoms did you first notice?—They used to come up and say they could not do anything, and they wanted to lie down and die, and to give up the whole thing. They were dispirited and disheartened, although they knew we were quite close to the coast.

4724. Were their gums affected?—I do not know about theirs; I know that mine were.

4725. Did you notice if their lips became pale?—Yes, they had pale lips.

4726. It would be a little interesting as the men were dark if you observed any discoloration of the skin?—They got that unhealthy look that a man does get when he just loses the gloss of his skin.

4727. But you did not observe any decided discoloration?—No.

4728. That would be a little difficult, would it not?—Yes, it would be difficult.

4729. Did you observe any swelling of the skin?—Yes, their legs were swollen a great deal in some cases.

4730. Was that in the neighbourhood of the joints?—Yes, principally in the neighbourhood of the joints. Some of them had the whole of their legs swollen, but others only round the knee.

4731. That was not an invariable appearance?—No, not invariable.

4732. Did the swelling of the knee prevent them from flexing the knee?—Yes, they had to hobble along with a stick.

4733. Was there any bleeding from the mouth or other mucous parts?—I did not see it with them, but when I got to Benguella for four days I was bleeding from the mouth the whole time.

4734. At the time the outbreak occurred were you making forced marches?—No, not at the time it occurred; but when the men were breaking down I made a forced march the last distance of 120 miles, and we got over very rough country. We did it in four days, and we got in early on the morning of the fifth.

4735. That was after the occurrence of the cases?—Yes; one man had died a day or two before I left the caravan, and the men then said they could not march, so I went on in order to send back assistance.

4736. Previously to the occurrence of this disaster you were proceeding leisurely?—Comparatively speaking, making fair marches; but for a month or six weeks before we had some very severe marching.

4737. With the exception of the two men who died, you succeeded in bringing all your party to Benguella, a point on the coast?—Yes.

4738. How were the patients treated when at Benguella?—When they got down there they had had a lot of limes and things and were then getting better. Some of them were sent to the Portuguese Hospital and were well treated by the Portuguese doctor there, but I was too ill myself to go and see much about them.

4739. Do you remember how you were yourself treated?—I do not know exactly what they gave me, but for four days I could not speak or swallow, and they were picking blood out of my mouth every ten minutes or quarter of an hour and using a syringe to syringe my throat out.

4740. You do not remember whether you had any acid food, or lemon juice, or vegetables?—The first thing I got I remember was some milk, and then they began with vegetables and tomatoes. The Portuguese had very good gardens there, and I got things of that sort.

4741. Was your recovery tolerably speedy after you arrived at Benguella?—Yes. I got in on the 4th and I left there on the 19th, and when I got to Loanda, a couple of days afterwards, I was fairly well. I was still weak and had got a few marks of the discoloration, but I was fairly well.

4742. Was the progress of recovery equally satisfactory with the other men?—The other men got well more quickly.

4743. Can you tell us if these men were subject to scurvy?—I had not known it from personal experience on any other journeys that I went; but Majors Monteiro and Gamitto went to Ma-Kazembe

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about 1836 or 1837, and they mentioned having scurvy amongst their party.

4744. But you yourself, excepting on this occasion, never experienced it?—I never experienced it or heard of it.

4745. And you did not learn from any of your men that it was a common disease?—No; they did not know what it was.

4746. Can you give us a general notion of the kind of food that these men generally had?—The natural food of the men on all ordinary occasions is simple flour boiled up into a stiff sort of porridge. Then occasionally about once a month or six weeks they are supposed to have meat and any little thing they get, such as different vegetables, or butter or grease or honey. They just put it with it and eat it as a relish, but their main staff of food is simply this, flour boiled up into a stiff sort of porridge.

4747. It is made of corn or Cassava flour?—It is made of Indian corn in some cases, and sometimes of the Cassava. In some countries you can only get Cassava flour.

4748. Did they not have any considerable or abundant supply of meat?—Very rarely. In fact with me they had more meat than they would have with anybody else or in any ordinary circumstances.

4749. Is there, generally speaking, an abundant supply of vegetation in that part of Africa?—We had been passing through a country where there was very small vegetation just the last 150 miles, except in the valleys. We were going over a very rough, stony, mountainous tract without much vegetation, but before that we had been through dense vegetation.

4750. These men would not often, would they, suffer from the absence of vegetable food; they would not often be deprived of vegetable food?—It was their main subsistence. There are many plants and mushrooms that they find in the jungle that they eat.

4751. I mean green or succulent vegetables?—We used sometimes to get beans in different places. I found a sort of bean that grew on a small bush, a little bean something like the horse bean; they very often got those, and then they would be very fond of boiling them and eating them with their porridge.

4752. Had you anything of the nature of cabbage, or any fruit?—We had bananas in many places, and sometimes the bananas are eaten not as a fruit, but they are gathered when half ripe and cooked as a vegetable; and they use the leaves of the cassava, and the leaves of a few other shrubs, and sometimes young ferns, and things of that sort as vegetables.

4753. The men who were attacked with scurvy seem to have been totally unacquainted with the disease?—Yes, they did not know at all what it was—they told me simply that they had got bad blood.

4754. From what they said you were led to believe that it was not a disease that they had previously seen?—No; I think they knew nothing of it; they had never seen it before.

4755. (*Dr. Donnet.*) What was the number of your men at the time when scurvy broke out?—56.

4756. Had you any white men amongst them?—No, only myself.

4757. Were there any half-castes?—No. There might have been one or two people with a strain a long way back from some of the old Arab blood, 100 years ago, but nothing of a recent date.

4758. Was there any difference in the colour of your men?—Yes, it varied a little, but not more than you see amongst people of the same tribe; there were no great variations.

4759. Had they suffered much before you reached Bihé?—We had very severe work and very little to live upon before reaching Bihé.

4760. Will you describe the nature of that work?—Long marches, carrying loads. We made our fair start to go to the coast in the end of June, and all July, August, and September we were constantly on the road, the longest halt at any time being about

two or three days. Sometimes we marched 10 or 12 days without stopping, and sometimes our marches would be from 6 in the morning to 4 and 5 in the evening.

4761. What weights did your men carry?—At that time they were only carrying on an average about 50 lbs. each, the proper load being supposed to be from 70 to 80 lbs.

4762. In what way were those weights carried?—Boxes were slung over a pole and carried by two men on their shoulders, and other men carried their bales either on their shoulders or on their heads, and shifted them about. The bales were lashed up in a cradle of branches, so that they could get it on to their shoulder, and then when one shoulder got tired they shifted it on to the other, and then they carried it on their heads, and so on, changing it round and round.

4763. Did they carry their food with them?—Yes. We used always, when we got to any place where there was food at all plentiful, to lay in a stock, if we possibly could, for going on with.

4764. Did your men go through much swampy ground, and, if so, did the wet caused by it produce any disease?—The swamps did not cause disease, but I think, after leaving Bihé, before the scurvy shewed itself actually, we got a bit of the rainy season, and then for several nights we had been wet through night after night, and one of the men died. I think we were all wet through. We were all very glad to get out of our camp in the morning, being rained on all night. There was not enough grass for making our huts in the usual way.

4765. What was the cause of this man's death?—He stopped behind one day, it had been a very long march, and he was missed, and then I sent men out to look for him the next day, and they brought him back at sunset, and during the night he died. He had been passing blood, and his legs and everything were swollen. He evidently was ill with scurvy and prostration from having been out. I think that the cold and wet, together with the scurvy killed him.

4766. Was this man not one of the two men who died from scurvy?—Yes, he was one of them. The other death occurred after. One of two men whom I left behind and who had to be carried, I heard died before they reached Benguela.

4767. I believe you were detained in Kilemba?—I could not get off very well.

4768. Did you undergo much privation whilst there?—No; whilst there we lived very fairly. There was an Arab there who was very kind to me, and used to give me milk and rice; and then all round the country food was plentiful enough. Indeed my men during the time that they were there lived remarkably well.

4769. Had you any opportunity of observing the inhabitants of Kilemba, and did you remark whether they were subject to any particular diseases; was scurvy amongst them?—No; there was a certain amount of leprosy, fever, diarrhoea, and rheumatism; those seem to be the usual diseases.

4770. How many times were you stricken down by fever before you reached Bihé?—I do not know exactly. At Unyanyembe for three months I do not believe I had a week or ten days clear of fever, and then I had fever constantly on the road from there to Ujiji; and I also had two or three attacks whilst on the Lake, but after that I had not so much fever, only about once in three months or once in two months, which usually I could trace to some reason.

4771. Did any of your men suffer from fever?—Yes, to a certain extent; but not so much as I did.

4772. Can you tell me whether the men who fell ill of scurvy had had fever before?—Every one of them had had fever at some time or another.

4773. Had this fever any influence in production of scurvy?—No: as we had been passing through a healthy country without fever for some time before.

4774. With the exception of these fevers, did your

men enjoy good health from the time you left Zanzibar to the time you reached Bihé?—One man died from consumption and two or three died of dysentery, and then there were several of them at different times had rheumatism.

4775. Were those men of intemperate habits?—Some of them were, but of two of our men who had scurvy very badly, and who recovered afterwards, one was a man who was a very strict Mohammedan, and who never would have drunk anything, and who always kept up his Mohammedan practices right through; the other was a boy that I brought home to England, and whom nothing in the world could induce to drink anything stronger than water.

4776. How many Mohammedans had you amongst your men?—All of them were nominally Mohammedans.

4777. What spirits did they use?—No spirits; they used to get drunk on native beer, or on a stuff made out of honey or fomented palm wine.

4778. You mentioned having had yams, sweet potatoes, oranges, and bananas; what other fruits were you able to obtain?—In the jungle we used to get two sorts of wild plum, and sometimes a small round, sweetish, pulpy fruit with stones in it.

4779. (*Admiral Inglefield.*) Was it guava?—No, not guava; we did get a few guavas, but very few; just in Bihé we found a few guavas.

4780. (*Dr. Donnet.*) You mention that you cooked your bananas; were they bananas or plantains?—Sometimes bananas and sometimes plantains; we used to get those enormous horse plantains about two feet long.

4781. What food did you chiefly live upon yourself?—I used always to have a sort of damper made of flour; and my drink was burnt Indian corn made into coffee. For meat I got anything that I could find, and for vegetables bananas and beans; and constantly I used to use ferns, and the leaves of the cassava.

4782. What was your usual drink?—Either water or this Indian corn coffee.

4783. You never attempted, I imagine, the drinks that were used by the blacks?—I used sometimes to get palm wine, which until it is fermented, is entirely unintoxicating, and I have once or twice drunk some of their poudy or native beer; but it was not very good.

4784. Have you made yourself acquainted with the history of the late arctic expedition, and can you give any opinion about the causes which produced the outbreak of scurvy in it?—My idea is that it was the damp, together with the hard work while sledging.

4785. Do you suppose that those causes would of themselves be sufficient to produce an outbreak of scurvy?—Perhaps not altogether by themselves, but with any very slight predisposition they would be sufficient to bring it on.

4786. You have had some experience of scurvy; can you tell me what these predisposing causes would be?—Anything that would lower the general state of the blood, I believe—bad food or not sufficient food, and long continued hard work without sufficient nourishment to keep one up to the work. There is a certain call upon the blood, and the blood gets deteriorated.

4787. (*Admiral Sir R. Collinson.*) Did you diet your men or did you simply supply them with money to purchase their provisions?—All the latter part I gave them cloth and beads to buy them food, because I found there was so much trouble and difficulty about the question of rationing them regularly.

4788. What do you think was the quantity of meat generally consumed by the natives?—The natives ordinarily only eat meat about once or twice a month.

4789. What did your men have?—It varied. In many places where fowls and things were plentiful, they would get them two or three times a week.

4790. Had you, previous to the breaking out of the scurvy, an ample supply of meat?—No, except just the short time when we were at Bihé; from June to November we were always more or less in difficulties about meat.

4791. Had you a sufficient supply of vegetables?—Not always; very often we were simply living on flour.

4792. In your opinion, you attribute the breaking out of the scurvy to the combined cause of insufficient food and hard work?—Yes, and also the wet. Just before it broke out we had wet camps for some time owing to the rain at night, and the men got thoroughly miserable and depressed.

4793. (*Admiral Inglefield.*) What was your previous service before you went to Africa?—I was in the steam reserve at Sheerness before I first determined to go out to Africa.

4794. Had you ever fever before?—Yes.

4795. What kind of fever?—The African coast fever some three or four times.

4796. Then you had been on the coast of Africa before?—Yes, on the east coast.

4797. Were the symptoms which you experienced the same as those which you had experienced before?—Yes, very nearly the same; there were slight variations sometimes.

4798. Was it intermittent fever?—I sometimes got intermittent, sometimes remittent fever.

4799.—Did you obtain milk in any quantities?—Very rarely. At Unyanyembe we got milk, and at Ujiji we got milk. Then when I was at Kalembe, an Arab there used to give me a little every day, but from leaving there until I got to within 40 miles of the coast I never saw milk again.

4800. It is considered a good anti-scorbutic; did you find it relieve you at all?—When I got to Benguella the first thing they gave me was milk, as soon as I was able to swallow again.

4801. Then scurvy is known amongst the natives there?—My people did not seem to know it; at Benguella there was a Portuguese settlement where we were treated for scurvy.

4802. I want to elicit from you whether scurvy is a common malady in Africa, or whether it was exceptional with you?—I believe the only case that I heard of in the interior was that about Major Monteiro and Major Gamitto; but at Benguella and along the coast there are fishing stations at points where there are no vegetables, and they are fed the same as on board ship, and there scurvy does prevail.

4803. What is their remedy?—They usually bring them up to Benguella to the hospital. The boats go round to the different stations, and when they find men suffering, they bring them to the hospital at Benguella.

4804. By whom is the hospital administered?—By Dr. Calessio, a Portuguese.

4805. Had you no other opportunity of communicating with him?—I was there a very short time, and I was rather ill the whole time.

4806. Have they lime juice in the form in which we use it, or how do they use the lime?—They use the fresh limcs.

4807. Are they considered equally good, do you know?—I do not know.

4808. You cannot inform the Committee whether the symptoms which exhibited themselves in your case and that of your men were the same as those which occurred in the arctic regions?—I believe that they were much the same, in the question of discoloration and swelling of one's legs, and bleeding from one's mouth, and so on.

4809. Had you any diet of salt meat?—No salt meat whatever; we had nothing European in any one point. I was by myself there for two years, and we only just lived on the country.

4810. Then it is clearly in your case attributable to something besides salt meat diet?—Salt meat diet could not have anything to do with it, because we were very often without salt.

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4811. Then you consider that damp and fatigue were the predisposing causes?—And insufficient food. It all tends in that direction.

4812. But vegetables you had always an abundance of?—Occasionally; not always, except flour; we did not always get those sweet potatoes.

4813. I mean such vegetables as bananas, or even unripe fruit, would contain a good deal of acid which would be beneficial?—Sometimes we went a week or ten days without getting much of that sort to use. It varied. In the tracts that we went through we were never any long time without other vegetables.

4814. I suppose the English potato is unknown there?—Yes, quite unknown.

4815. (*Dr. Fraser.*) You have said, I think, that although, as far as you know, scurvy is rare in the interior of Africa, cases are not uncommon on the coast near Benguella?—No.

4816. And you further say that vegetables are certainly rare on that coast?—Yes, where those stations are where those people get scurvy. They are little fishing stations, consisting of a few men with a boat, on some high rocky point or cliff, and all their provisions are just flour and salt fish whilst there. They are stationed there for months and months at a time, catching fish, and then bigger boats go round to collect the fish and oil.

4817. Then these cases occur in a fishing community?—They are not exactly fishing communities. Those stations are taken up by different merchants, who send a couple of boats' crews to live there to fish.

4818. And who probably, therefore, have no lack of fish food?—No, I should think not.

4819. But who you know have a scarcity of vegetable food?—Yes, they have a scarcity of vegetable food.

4820. (*Dr. Donnet.*) Did you observe many cases of leprosy amongst those cases which you have mentioned?—Not very many cases; but, it is a curious thing, I heard of a district where all the people were supposed to be leprosy. I did not see it myself.

4821. I mean amongst the cases that you saw?—No, not amongst the cases I saw. They were very general in the district, and in a 50 or 60 miles' march one would see one or two, and they did not seem to have any particular horror of it; but in this place, where they say everybody is leprosy, I believe they scarcely ever stop or have any communication with them. The story of the natives is that it is caused by drinking the water there.

4822. Do you think they believed that it was contagious?—Yes, they believed it was contagious, because they did not allow those people to come out of this country. This is only as I was told; I know nothing except from hearsay about this district where they talk about all the people being lepers.

4823. I suppose they have not any fresh meat except fish in those little fishing communities which you mention, any more than they have vegetables?—No fresh meat whatever.

4824. Do you think that any of the cases called leprosy were scurvy?—No, I do not. The Arabs at Zanzibar knew the disease leprosy well, and talked about it.

The witness withdrew.

JOHN DENIS MACDONALD, ESQ., M.D., Deputy Inspector-General of Hospitals and Fleets, R.N., F.R.S.,
examined.

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4825. (*The Chairman.*) You are a Deputy Inspector-General of Hospitals and Fleets, and at present hold the position of Professor of Naval Hygiene in the Army Hospital at Netley?—Yes.

4826. (*Dr. Donnet.*) Have you formed any opinion what a ship intended for arctic service, should be with regard to size and tonnage?—I visited the ships after having been completed, and I understood that it was a matter of importance, as far as the temperature was concerned, that they should not be very large. To combat that idea, there is the question of air-space. It struck me that there was no provision made for the escape of air as in natural respiration, which is the great difficulty, it seems to me, in all ship ventilation; therefore, if provision is made for the escape, the ingress of pure air would be sure and certain. Then came the difficulty about introducing cold air, and it would be a question whether that air so introduced may not be warmed by passing through or over a heated surface on entering the ship; but otherwise I must say that I have not considered much the requirements of a case of the kind, except that the lining of the ship, which I believe was attended to, should be made of a non-conducting material sufficiently thick to be effective.

4827. I believe you are acquainted with the manner in which the ships of the late arctic expedition were heated?—The particular method adopted for heating arctic ships, I must say, had not been explained to me.

4828. Are you acquainted with the Sylvester system?—I understand it to be simply that of conducting a current of air over a heating surface, and thereby delivering it into the body of the ship. That was originally suggested in the case of the Houses of Parliament, I think.

4829. Have you any experience about heating ships by means of hot-water pipes?—I cannot say that I have. I do not know whether that is done except in the case of Dr. Edmonds' system, where pipes carrying steam are led into uptake shafts; but ships specifically warmed upon the hot-water

system I am not acquainted with, especially British ships. I believe it has been adopted in the French service.

4830. Have you any experience of this system of warming?—Except in houses, not as applied to ships, and no doubt it is very effective in the case of houses.

4831. Do you consider the system of warming by hot-water pipes as good as that by means of hot air?—The hot-water system seems to be rather superior, as containing a larger body of heat, and delivering it all round the circumference of the conduits. These are hygienic questions bearing upon what would be suitable, I should think, in cases of the kind.

4832. With respect to the system of warming by hot-water pipes, I may mention what occurred in Berlin in 1848, when the Prussian soldiers were quartered in the Museum of that city; these men suffered much from debility, and though not exactly ill, they were depressed, and on inquiry being made to account for their state no other reason could be given but the fact of the atmosphere, in which they lived and which they breathed, being warmed by hot-water pipes?—I have had experience of the air heated in this way in the Haslar Hospital, especially in the wards set apart for consumptive people, and I think it was found there rather to induce hæmoptysis. This is one of the objections, in fact, to the Arnot stove, but that is not hot water; still the same effect is produced of superheating the surrounding atmosphere.

4833. Then I infer from your experience, that the system of warming by hot-water pipes is not conducive to the health of the men?—I would not say that; I imagine if you could supply hot-water pipes to an arctic ship, calculating of course the loss of fuel, it would be a most desirable thing. You have to consider the waste of fuel. The expenditure of fuel, I was noticing, was not very great.

4834. What do you think should be the cubic space of air for men living as the arctic men did on

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a lower deck?—The question would be not the exact cubic space alone, but the renewal of the air occupying that space. A man might live in a very small space, such as the cabin of a ship may be, with safety if the air was sufficiently often renewed. He would require 3,000 feet per hour if it was done according to rule. I mentioned to Dr. Moss, on visiting his cabin, in which I certainly noticed no possible escape for the air, that it would be an important matter to have provision made for escape, which could at the same time be closed, if necessary, temporarily.

4835. Could you offer any suggestion towards the escape of foul air?—In a wooden ship escape could be easily made by the openings between the timbers, and that commanded by valves would answer all purposes.

4836. What sort of valve would you adopt?—Any valve to effect closure or patentcy as may be required.

4837. In the arctic service would not this be objectionable?—I think not, because it would be quite optional with you whether you would close it or keep it open. If it is found to be a relief to open it, it might be temporarily opened, or closed if found not too oppressive, or if it hurt the men by the draughts. But there having been no openings made in the original construction, of course the principle could not be applied. In fact I understand it was the idea of the Committee who, sat upon this question to box up everything, to close the space as much as possible to prevent the ingress of the outer air, and that they would be satisfied with an additional percentage of carbonic acid in the interior provided that the external cold were precluded from entering.

4838. You are acquainted with the difficulties which attend the ventilation of the living deck; what amount of carbonic acid in an atmosphere would you say would be considered an excess?—The standard of practicable purity in an enclosed space is .6 per 1,000 volumes; that signifies that .4 would be the state of the external air, and the addition to that by breathing would bring it up to .6 inside. If you can preserve this standard by the introduction of air from without, it is about as much as can be expected in any circumscribed space. The standard may be exceeded, and will naturally be so under circumstances such as where the hatches and ports are closed in bad weather, and so on, but then there would be a very considerable amount of carbonic acid, which is the measure also of the other organic matters which are eliminated from the bodies of men by the perspiration and the transpiration of the skin.

4839. In the course of your service in the Navy, have you had any experience in cold climates?—No, I have not; I have spent the chief part of my service in tropical districts in the South Seas, and in the West Indies.

4840. After having visited the ships and made yourself acquainted with the system of ventilation, have you any suggestion to offer towards its improvement?—I think one point would be to make provision for the escape of air by special conduits between the timbers in wooden ships, which would be quite practicable, and so arranged as to be shut off if found necessary; and that provision should also be made for warming the air on entering the ship and being distributed through it. Of course the special manner in which these conditions should be carried out would be the subject of consideration and adaptation according to the design of the ship. The usual thing is that ships are built first and ventilated afterwards, which is decidedly a mistake; the ventilation should enter into and form a part of the original design.

4841. At what temperature should the deck in the Arctic Seas be kept with regard to the health of the men?—The temperature in the Arctic Seas might be very much lower than our own temperature here with advantage. We notice the case of arctic officers who have been a long time subjected to very low tempe-

tures experiencing a sense of oppression on an increase of temperature, which would to us appear to be rather severe cold. I think Sir Edward Parry expressed that feeling; and it struck me as being an interesting point in the case; in fact as a matter of surprise it was mentioned by him.

4842. What amount of moisture may exist in the atmosphere without being detrimental to the health of the men?—The saturation of the air at any temperature will depend upon the degree of that temperature, and it is always well to be considerably under the point of saturation; it is taken as 100° for every temperature, and then any difference could be taken as the relative humidity, or a percentage of it. Of course the higher the temperature is the greater will be the absorbing power or property of taking up moisture; and it is in this way that the interiors of ships in general are so very moist; the temperature being increased this hygrometric property is of course favourable to the accumulation of humidity.

4843. Have you formed any opinion upon the selection of the men best fitted for arctic service with regard to their ages, their height, their weight, and their temperament?—I have always held as a view of my own, I do not know whether it may be right, that a fair race would be rather suited to arctic service, and sandy persons from our own people. The Esquimaux are dark enough, but there is greater endurance apparently in the sanguineous temperaments, still that is a question which I do not think has been fairly considered, the temperament best suited for sustaining a low temperature. As to ages, youth, I think, would be rather an advantage; from 20 to 30 they would be capable of more endurance. As to height, a compact frame about 5 feet 6 or 7 I do not think would be too small or too large. I imagine that a medium-sized individual would be more likely to combat physical external conditions.

4844. Can you offer the Committee any opinion upon the amount of exercise that a man living during the winter months in the arctic regions should take?—I think the exercise should bear a relation to the external temperature, and also to the physical power of the individual, if it be a healthy man. All exercise within the limits of exhaustion should be regarded as beneficial, especially when temporarily carried out.

4845. Have you, in your experience in the naval service, ever observed scurvy?—Never; I have never seen a case of scurvy in the naval service in my experience; I remember during the famine which took place in Ireland having seen some cases then, but those are the only cases which I have ever had an opportunity of witnessing and observing.

4846. Would you mention the symptoms which you observed in those cases?—In those cases we had the usual description of petechial patches on the skin, the rigidity of the hamstrings, the appetite in many cases certainly not impaired, but rather increased, and clean tongues, not necessarily foul, unless in acute forms of the disease; and in that case you have a foul tongue. Then inability to change the position of the body without giving rise to alteration in the circulation; for instance, on suddenly raising oneself from a recumbent to an erect position; that, of course, might be from a descent of blood from the head, and it begins with this generally; dyspnoea, shortness of breathing, an inability to put forth exertion to any extent, indisposition to move, and especially to going up-hill or upstairs, or where any additional effort, in fact, is required.

4847. Do you remember any impairment of vision in any of those cases?—No, I have not seen cases of nyctalopia, but I know they are frequent under those circumstances as a scorbutic condition.

4848. What was the state of intellect of those scorbutic men?—In some instances it passes in the acute form to the delirious state, but in general, dulness and depression of spirits may be noticed.

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4849. Was their intellect clear?—Yes, in the minor cases, but not in the acute form.

4850. Have you known any instance of the appearance of scurvy where a sufficient quantity of vegetables has been supplied?—No, except in a case during the Irish famine, where I noticed one remarkable fact, that scurvy was very frequent where there was a large amount of turnips eaten,—in fact, where turnips were the staple article of diet—and still scurvy was developed. That is the only case which I know of a vegetable diet having at all exhibited failure, and this is rather the recollection of a circumstance than one that might be advanced, because I think Professor Parkes alludes to the antiscorbutic properties of the turnip.

4851. Do you know whether men supplied with fresh meat without vegetables become subject to scurvy?—I know of the case of the Australian colonists, who, while they eat plenty of fresh mutton, are, at the same time, subject to a very bad form of scurvy arising from limiting their diet to one description of food, to fresh meat alone, and the absence of vegetable food. I mention this with reference to the fact that it is commonly supposed that salt meat produces scurvy, but that idea is comparatively abandoned. In fact, there is a memorable case mentioned by a surgeon-major who had charge of a party at the Cape, where salt meat had actually produced a beneficial result in the case of scorbutic symptoms being present; it was the change of diet, in fact, that was beneficial.

4852. I have been informed that the Gauchos, in the Argentine Republic, live mostly upon fresh meat with little vegetables, and yet have no scurvy; are you aware of this fact?—I am aware of similar facts, but I think that the position there could be fairly established if we were to inquire into the history of those people to see whether they do take sufficient vegetable matter to account for the fact. It has been advanced with regard to the Esquimaux, that they take no vegetable food, but they are in the habit of preparing the paunch of the reindeer and its contents, and the benefit of this is well known amongst the Esquimaux. Again, if we are to derive any argument from the acclimatisation of persons, and especially a race like the Esquimaux, and what they would be able to endure, it would be certainly a mistake to compare that with an European constitution. They are a stunted race, and how far even that condition may be due to the absence of vegetable food we do not know.

4853. The Esquimaux eat a quantity of blubber?—Yes, blubber is eaten as well, but they prepare the whole of the interior of the reindeer, which is dried and eaten *en masse*, and prepared in this peculiar way, it is probably beneficial, so that it could not be asserted of the Esquimaux that they were without vegetable food.

4854. Are you aware that they live upon scurvy-grass, and sorrel, and cranberries, which grow in arctic regions?—Yes, where they are within reach.

4855. I would like to have your opinion upon lime-juice and its effects upon the system as an antiscorbutic?—The benefit of pure lime juice is a time-hallowed fact, and in our service it has been adopted very much earlier than in the French navy, and that from its long-known antiscorbutic property. Then as to what it is in the lime that may be regarded as the active principle, I think we are driven at once to the admission that it is the vegetable acid and not the alkali contained in the juice.

4856. Do I understand you to say that the citric acid is the antiscorbutic principle?—Yes, certainly, and a certain portion of malic and tartaric acid as well, in very small quantities.

4857. Do you look upon citric acid as a good substitute for lime juice?—The best substitute for lime-juice with which we are acquainted; but the question simply turns upon this, whether citric acid in its isolated form may not be regarded as inferior to citric

acid in its natural combinations. This, I think, has been admitted by everybody. From early times, also, though many experiments have been made, by Dr. Lind with reference to the merits of pure citric acid, and also by Dr. Trotter, who instituted a comparison between the action of pure citric acid and lime-juice in scurvy, and his reports are very satisfactory and in favour of the antiscorbutic property of isolated citric acid. Sir William Burnett, during his administration as Medical Director-General, usually supplied citric acid with the lime juice, and also nitrate of potash, which was at that time considered to be an antiscorbutic at least requiring to be tested, and he desired the medical officers in charge of ships to test the relative properties of those three agents; and some of the returns which have been examined by the late Professor Parkes are very important as showing the anti-scorbutic property of pure citric acid.

4858. Have you yourself any experience of citric acid as an antiscorbutic?—No, upon the ground that I have never had any cases of scurvy to deal with; but I believe that the Medical Director-General, Sir Alexander Armstrong, has used citric acid or supplied it where the lime juice was exhausted. My own feeling is that nothing will beat pure lime juice, but of course there are the carriage and other matters to be considered so far as rendering it practicable. We have, as Professor Parkes remarks, many instances in the pharmacopœia where the therapeutic action of agents is more effective in their natural combinations than in an isolated form.

4859. Do you attach any importance to the value of potash as an antiscorbutic?—No, most clearly not. Nitrate of potash is known to be the worst of all antiscorbutics that have been submitted to trial. And again, in the ordinary ration of cocoa there is a very large amount of phosphate of potash, and if phosphoric acid and potash were of any advantage it would have been shown in this last case. On the other hand, the quantity of potash contained in lime juice is less than a grain per ounce. Then the phosphoric acid amounts to about $\frac{3}{10}$ ths of a grain, and consequently to attribute the antiscorbutic effect of lime juice to potash or phosphoric acid would be a mistake.

4860. Have you made yourself acquainted with the history of the outbreak of scurvy in the late expedition, and have you formed any opinion as to the causes which produced it?—My own impression was, on looking over the papers, that the physical endurance of the men was taxed to the furthest, and beyond the proper amount.

4861. Do you think that a degree of enthusiasm in young men will produce a state of corresponding depression when difficulties offer?—These are all conditions which of course favour the effect of the radical defect of the diet, which is the absence of fresh vegetables, or the next best substitutes, the vegetable acids, particularly in the form of lime juice. On looking over the scale of diet, I do not think anybody could complain of it; the scale of diet employed for the ships was a very excellent one, containing many antiscorbutics. There were lime juice, pickles, compressed vegetables, preserved vegetables, and currants used with suet for the puddings; all these are antiscorbutics. There has been a complete elimination of all these antiscorbutics in the sledge diet, with the exception of two ounces of potato.

4862. Do you consider the sledge ration insufficient?—I consider that the pemmican is rather more than perhaps would be required if you were sure that they would consume it; but from what I can understand by looking over the papers, there was an indisposition to take even the necessary amount of pemmican on the very start of the sledging expeditions.

4863. Did this dislike to the pemmican arise from the sudden change of the diet to which they had been accustomed?—I think it would proceed with loss of appetite from extreme exhaustion, which

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would give rise to an indisposition to consume the food. I do not know whether it has been found to be the case, but I have been since informed that the pemmican induces flatulence, and was rather disapproved of by the men. There is no mention made of this in the papers, but on several occasions it is remarked that there was no fancy or disposition to take the pemmican, and that was really the staple article of the dietary.

4864. Have you formed any opinion upon the value of rum as a sledge ration?—I imagine that the benefit of rum is chiefly the cheerfulness that it inspires. In the polar service it has been found rather a disadvantage to give a ration of any alcoholic spirits, but I am quite sure that half a gill of rum would not seriously affect the physical powers of any healthy man.

4865. In the evidence given to the Committee it has been said that when rum was supplied to the sledge parties during the luncheon time, or in their mid-day halt, the men were not so well able to do the work as they were before; does this assertion coincide with your views?—That is an admitted point, and the administration of a little more alcohol would make that still more evident.

4866. Do you think that the long absence of light had any effect upon the health of those men?—Not specifically as producing scurvy. We know that there are certain other conditions produced in the body by the absence of light, such as an accumulation of fatty matter in the interior; as for instance the development of Bright's kidney; and even cats suffer in cellars and captives in dungeons in consequence of the absence of light, but you can only attribute to that a predisposing condition, certainly not a cause.

4867. Have you formed any opinion upon the value of tea in arctic service, especially on a sledging party?—Tea has been used in some cases as a substitute for rum, but it does not seem to have produced any beneficial effect. At the time when scurvy was more general in the fleet the administration of tea was stated to have been beneficial. I think Dr. Fletcher, in his very excellent account of that time and of hygienic matters connected with it, referred to the state of health of quartermasters and boatswains and those who were sufficiently provided to take an extra stock of tea and sugar, and their freedom from scurvy was observed, but I think tea is not admitted to be an antiscorbutic; I think there is no good evidence of its anti-scorbutic properties.

4868. (*Dr. Fraser.*) You do not think the question of air-space very important, excepting in so far as it influences the question of the air renewal?—No; I merely thought of the question of space with regard to preserving the temperature. It must be more easy to warm up a circumscribed portion of air than a very large amount. I think that was one of the questions which the Committee had to think of, whether a large or small ship would be better to employ in this case.

4869. The question of space is important, however, in so far as the renewal of air is concerned?—Yes, certainly.

4870. Could you give us generally the quantity of air which you think is requisite to maintain a healthy atmosphere in a confined space?—The tables are given in Dr. Parkes' Manual. I think it requires a supply of 3,000 cubic feet per hour. The cubic space for various purposes will vary. For instance, for sick persons it would want to be double the amount that persons in health might require.

4871. If 3,000 cubic feet or thereabouts of fresh air be requisite in order to maintain a pure atmosphere, and if the air-space per head be about 100 cubic feet, how often will the air in the confined space require to be renewed?—You start with the position that 3,000 cubic feet is required per hour; then the size of the space I should think would alter

that question, it is simply a matter of calculation. There is a table showing exactly what would be the amount required in this way in Professor Parkes' Manual. Of course it must be multiplied 30 times in the case that you have put.

4872. In this country, with the ordinary temperature of this climate, can you tell us how often it is practicable to renew the air in a confined space?—You must adopt, I should think, artificial means to effect it in any instance where the ordinary heating property of the interior will not cause a sufficient ascent or change of the air by the difference of specific gravity of the external air as compared with that which is contained in the apartment.

4873. In those conditions, that is to say, that air in a confined space requires to be renewed 30 times per hour, would you not have a very decided draught or wind?—Yes, in small spaces. The space must be sufficiently large to obviate the draught by the entrance of the required quantity, and if the space is very small of course you would have many miles per hour coming through the aperture, which would be very prejudicial to health. There is a very remarkable case as showing the effect of draught in the late system of ventilating sewers suggested by Mr. Stott of Halifax. In this case he adopts the principle originally patented by Mr. Sutton for ventilating ships, that is of extraction by heat. A conduit leads from the main sewer into one of the furnaces of a neighbouring mill, and the current produced in this case over a very considerable area is quite enough to cause a draught through all the other communications between the houses and the sewer, and the result is that no rats are found now; they cannot stand the draught. The rats were very numerous formerly, but this continual draught in the holes made by them, which they traversed in passing from the house to the sewer, was so great as literally to be unbearable to the rats.

4874. If it be inconvenient to renew the air as often as 30 times in an hour in a confined space in a temperate climate, must it not be very much more inconvenient to do so in a very cold climate?—I should think so.

4875. Would the effect of cold air moving with considerable velocity not be more marked, if that air were very cold, than if it were of the average temperature of this country?—I think that draughts might be obviated by having a sufficiently large space, and also dividing the air in two, by having conduits of a sufficiently large size. The great mistake seems to be small tubes and small chambers, and everything upon an insufficient scale. It is my humble opinion that if suitable provision is made for the escape of foul air in all cases of ship ventilation you will have a perfect renewal of the air without mechanism of any kind. The space where the foul air accumulates is between the beams and the angle formed between the deck and the ship's side, and the way of escape should be in that space. This of course would be over the shelf-piece so as to communicate with the openings between the timbers, if those were kept patent.

4876. Do you think that the renewal of air with the requisite frequency could be effected more conveniently if the air previously to its distribution in the confined space were heated, than if it were admitted cold?—Yes, I think so.

4877. So that in the ventilation of arctic ships it might be advantageous to heat the air before its distribution?—Certainly.

4878. By that means you think probably that a more successful ventilation could be effected?—Yes.

4879. You have told us, I think, that in your opinion '6 per thousand of carbonic acid represents an impure atmosphere?—Yes, I should say that when it exceeds that amount some change should be made.

4880. That is nearly the maximum limit in your opinion?—Yes.

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4881. What is your opinion of an atmosphere containing from .4 to .5 per cent. of carbonic acid?—It would be very terrible I should say, because it would be the measure of a very large amount of organic impurity.

4882. If you were told that an analysis of the air on the main deck of the arctic ships gave the results which I have just stated, would you consider that that atmosphere was one likely to be very deleterious to those breathing it?—Certainly, very deleterious indeed; there is no doubt about that in the world.

4883. I will not enter into the question of the moisture which is condensed, any further than to ask you whether the condensation could to any extent be prevented by the more frequent renewal of the atmosphere that would be effected by admitting heated air?—Yes, of course you will then get rid of the humidity to a great extent, and with a free circulation of air the question of humidity would almost entirely subside.

4884. You have given us a very interesting instance of scurvy having occurred during the Irish famine on a diet consisting largely of fresh turnips?—Yes, but that was the sole diet.

4885. Do you not think that that represents a starvation diet, and not only a scorbutic diet?—Yes, I think so.

4886. Turnips, indeed, are not generally looked upon, are they, as the most antiscorbutic of vegetables?—No, not the most antiscorbutic; although belonging to the cruciferae they are wholesome, and antiscorbutic perhaps. That was certainly proved in that case as well as I remember.

4887. The occurrence of this circumstance does not modify, does it, in any degree the opinion which you have already stated as to the etiology of scurvy?—No.

4888. You have told us that in your opinion the evidence in favour of the antiscorbutic properties of citric acid is such that although not sufficient to allow us to arrive at a decided opinion, it warrants a further trial in the direction of testing its properties?—Yes, with a reserve of lime juice, because I think it is a very serious thing for any person holding the position, for example, that Sir Alexander Armstrong, the Medical Director-General does, to adopt a suggestion upon the ground that citric acid is the only effective agent, and to withhold the supply of lime juice, and to order the general distribution of citric acid. Then if it was found to be ineffective in any particular case, it would lay the experiment open to censure.

4889. You think that there is sufficient evidence however to show that neither potash nor its combinations have any antiscorbutic property?—I think so. As you know, that was advanced by Dr. Garrod.

4890. From your position as teacher in the important Medical School at Netley, you have had occasion to enquire carefully into the etiology of scurvy with a view to satisfy yourself upon the subject?—Yes.

4891.—Can you give us generally the results of your enquiries and the conclusions at which you have arrived?—It seems to me that man must be regarded as an omnivorous animal, that is the first premiss, and that the waste of his system must be replenished with animal and vegetable food, and if there is a monotony of diet, and especially a deprivation of vegetable food, the conditions that are developed will give rise to scurvy. The blood itself suffers change, though the precise nature of it is very imperfectly understood; in fact, contradictory opinions as to the condition of the blood, as to the amount of albumen, fibrine, salts, and red globules in it, exist even at the present time. But all evidence goes to show that it is the deprivation of vegetable food which is the cause of scurvy. The want of food generally in some conditions may happen without scurvy. Persons may be debilitated from a variety

of causes without producing scurvy. Scurvy is the specific effect produced by the deficit of vegetable acids particularly which may be eliminated from vegetable food. That seems to me to be the cause of scurvy, and if a totally animal diet is adopted, those vegetable principles which are essential to the integrity of the blood being in fact wanting, scurvy will be sure to arise.

4892. There may be an abundance, may there not, of fresh animal food and still scurvy occur?—Yes. I have seen it in Australia. I have not seen cases myself or had an opportunity of treating them, but from my acquaintance with the colony I have been informed that very bad scurvy indeed happens to colonists who are not provident enough to grow vegetables, and who live entirely upon fresh mutton, and very beautiful mutton it is.

4893. You do not know, do you, from your own knowledge, that preserved potatoes have been imported into Australia in order to supply this deficiency?—Yes; potatoes have been imported. There seems to be an indisposition on the part of the colonists to grow vegetables to the amount necessary.

4894. You have said that, for the production of scurvy, there must be an absence of certain constituents found in vegetables?—Yes.

4895. You also said that these constituents are probably organic acids or their combinations?—Yes.

4896. Can you further inform us if turnip is a vegetable containing much organic acid, and what?—I do not think there is much organic acid in turnip; I am not aware of any. Indeed, from my own knowledge of the composition of it, I could not give any stated information.

4897. The great bulk of turnip consists of water, does it not?—Yes, that we know, and a large amount.

4898. And the salts are very small in quantity?—Yes, there is a very small amount of potash particularly.

4899. Can you further tell us why lime juice has been introduced as a prophylactic or as a remedy for scurvy?—The knowledge of the fact of its possessing this property seems to be of very early date. I do not know exactly when it originated, records go back to the 16th century, but in the history of the use of antiscorbutics in the navy extract of malt and molasses preceded the adoption of lime juice; and it was only by the repeated applications of Sir Gilbert Blane that the Admiralty caused the supply of lime juice to be issued by order. That was about 1798, the year of the Irish rebellion. Since that time there has been some difficulty experienced in preserving lime juice from spoiling, and it was suggested, in accordance with the views of Lind and Trotter, that as citric acid was the potent agent if they could procure this in a separate form, it would be equally effective and capable of being preserved without injury on board ship; but subsequently when a better method of preparing and preserving lime juice was adopted, citric acid was superseded; and then it became the ordinary belief that lime juice was superior to citric acid. On this account apparently, but not with sufficient evidence it is now the generally-received opinion, and one that I very much accord with myself, that citric acid in its natural combinations would be more assimilable than in an isolated state.

4900. It was as a substitute for the fresh vegetable juices that lime juice was introduced?—Yes, at a very early date.

4901. You have considered, I think you have already told us, the dietaries of the recent expedition?—Yes.

4902. What is your general opinion with reference to the scale of diet on board ship?—The scale of diet adopted for the ship I consider to be very efficient indeed; in fact, there can be very little fault found with the general diet sheet.

4903. Then you are not surprised to learn, are you, that the examinations of the men at the end of the winter by the medical officers show that the health had been maintained in a remarkably good state?—I am not surprised.

4904. You have also considered, have you not, the dietary of the sledge parties?—Yes.

4905. What is your general opinion respecting it?—I consider that all the antiscorbutics contained in the general diet sheet have been eliminated in the dietary of the sledge parties, except the two ounces of potatoes.

4906. Do you think that the proportion of vegetable food represented by the two ounces of potatoes is sufficient?—No; it was proved to be insufficient there in its preserved state; and it is an admitted point that the antiscorbutic property of potato is greater in the uncooked state than after having been subjected to the preparation which would be necessary to constitute the preserved potato. We know that there is in the potato citric and tartaric acid as well, and the antiscorbutic property of potato also is a time-hallowed fact.

4907. Putting aside the result of the experience gained in the recent expedition, do you think that two ounces of potato is sufficient to represent the antiscorbutic element in this dietary?—I should not think so. Two ounces of potato would not be enough to my mind. I think that unless you can prove that the men take all the diet assigned to them, the actual chemical composition of the food cannot be fairly tested. It is very often considered that a healthy man requires a certain number of principles; and although in the analysis of the diet which furnishes these principles they say this is an excellent diet, you must exceed that very considerably to be effective. Take rice, for example. Rice is said to be very easily assimilable and to leave the stomach in about an hour, but then a very small portion of the rice is really appropriated for the supply of the system, the larger portion, in fact, forming excreta.

4908. Still it is important to know the food principles in a dietary, the other conditions being also ascertained?—Yes, certainly.

4909. Have you ever had any opportunity of examining pemmican?—I have not even seen pemmican, but merely a description of it. There was a portion of it sent to Netley, which was lately examined by Dr. de Chaumont, but anything further than a general idea of it I cannot say I possess. We were very anxious to get samples of the diet used in the Polar Seas. In fact, I wrote a letter upon that subject, but it could not be obtained.

4910. I understand from you that you do not consider that the darkness, the extreme cold, the general exposure and dampness, or even the possibly vitiated atmosphere can be regarded as other than predisposing causes?—Certainly.

4911. And that, independently of those causes, and even in their entire absence, scurvy may occur by another cause which must be regarded as the true specific cause?—Yes; that is exactly my opinion.

4912. And your opinion is that that specific cause is what?—The absence of fresh vegetable food.

4913. Have you made any experiments with the lime juice supplied to the arctic expedition?—It has been examined with reference to the fragrance of the extract, and also the amount of acidity. I examined the acidity myself, and I found the acidity equivalent to 39·2 grains of citric acid per ounce.

4914. Which shows a lime juice, I think, containing an amount of acid rather above the ordinary amount?—Above the Board of Trade standard, but not above the ordinary service lime juice, because I have analysed several samples, and I have found in some as far as 42 and more grains, but 30 grains per ounce is the standard of the Board of Trade. Both the sample from the "Alert," and the one from the "Discovery," gave the same amount of acidity, and I suppose it was supplied from the same source.

4915. You are acquainted with the general symptoms of scurvy, are you not?—Yes.

4916. Can you tell us if there is the slightest reason for supposing, so far as you know, that scurvy presents different symptoms in arctic regions to what it does in other parts of the world?—The only thing I should say with regard to that would be that the conditions which give rise to scurvy would be more easily developed in the arctic regions than in temperate climates; for instance, the waste of the body requiring a large amount of repair in those regions would necessitate a higher standard of food and scale of diet; and if under those circumstances excessive labour is not supplemented by an actual increase in the diet roll, and a sufficient supply of either fresh vegetables or the best substitute that we know of, namely, lime juice, scurvy would be inevitable.

4917. But I rather wish your opinion respecting any difference that is presented by the disease itself or its symptoms.—That I cannot advance.

4918. So far as you know, what would you say?—So far as I know, I am not aware that there is any difference in the scurvy in temperate or in cold climates when once developed.

4919. You have had occasion, I dare say, to study the symptoms of scurvy in different parts of the world?—Yes, from the accounts of them.

4920. And you have met with nothing to lend any support to the view that the symptoms present in arctic regions are different from those in temperate or warm climates?—No.

4921. Is there anything remarkable that has struck you with reference to the last outbreak which you would wish to tell us about?—I do not think there is anything particular. It seems to me to be cause and effect as clearly defined as anything of that kind could be.

4922. It was an ordinary outbreak of scurvy?—Yes, dependent upon causes which we know were in operation. The energies and physical powers of the men had been taxed too much, and consequently, with the elimination of all antiscorbutics from the diet, one could scarcely expect any other result if the service were continued long enough.

4923. (*Admiral Sir R. Collinson.*) You have stated that this is a case of cause and effect; are you aware that in previous arctic voyages longer sledge journeys were made, after passing a winter, without any signs of scurvy appearing amongst the crews of those sledges?—I know that that has been stated, but I think that without looking back into the history of those individual cases it would lead to a very false impression if we founded our doctrines upon negative cases of the kind. If we go back into the history of those individuals, previous dietary conditions and other points which were not brought to the surface would be found out on investigation. I believe in this very expedition there were two sporadic cases of scurvy anterior to those that took place in the sledging crews. They were apparently individuals who were of dissipated habits; and in one case it was very likely that the man did not take his lime juice at all.

4924. Then you think that the condition of the ships' crews of the "Resolute" and the "Assistance" must have been different from that of the "Alert" and the "Discovery"?—I think it would be found out to be so upon enquiry; that is my conscientious view of the case.

4925. (*Admiral Inglefield.*) Perhaps the most extraordinary account of people under great exposure and having bad food, is that which I have before me, namely, an account of the people who drifted from the "Polaris." You may remember that a party who left the "Polaris" on the ice were nineteen souls in all, and that they were six months from the 15th of October to the 30th of April, over 196 days, upon the ice. They carried from the ship only pemmican and biscuit, and were entirely supported during that time upon seal-meat and bear's flesh, and yet no sign

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of scurvy broke out amongst them; can you attribute anything special to their case?—It has been considered that the oily matter that they took might have been effective in that way upon the ground that the Esquimaux escape scurvy by eating blubber; and we know that there were some casks of lime juice left by the "Polaris" at a dépôt there.

4926. This party had none, for we have it in their own account published by Captain Tyson, that they had nothing but pemmican and bread, besides what they could catch, and they had no vegetable of any sort; but amongst them there were an infant at the breast, three little children, and two women, nineteen souls in all?—I look upon that as a negative case, and one which, perhaps, if inquired into, would be accounted for: but the overwhelming weight of evidence, in other cases would show the position to be sound, that the deprivation of fresh vegetables, and the monotony of the other diet would give rise to scurvy, and would be in fact the efficient cause.

4927. When you speak of creating ventilation in a ship, would you suggest that an engine or some other means should be employed for pumping out the foul air, such as I think is now used in the House of Commons, and allowing the fresh air to find its way in?—Yes. I consider that to be the most perfect system of ventilation that can be. I take an instance from nature itself. The ventilation of the bivalve mollusc, for example; because, of course, although it is in the water, the system is just the same, the ingress and egress being provided by two distinct syphons, one for ingress and the other for egress; I think we are getting to this position as a perfect ventilation. To imitate open air conditions as nearly as possible in circumscribed spaces must involve the two things, ingress and egress, and in many cases, especially inside, extraction is really the best thing that can be done. But to inject pure air into the chamber on the plenum principle, and to cause diffusion as it were to dilute the foul air already there, and bring the whole place into a state of tension before any escape can be made, is certainly a false principle. The system of ventilation by extraction, whether by heat or mechanical means, would no doubt be the most effective.

4928. I remember that in the Queen's yacht, the old "Royal George," it used to be the custom for the medical officers to examine the air, and there was an apparatus fitted on board on purpose for pumping the foul air out of the Queen's sleeping cabin, and allowing fresh air to come in in its own way through apertures in the doors or ports?—Yes; but if you had a special channel for it, that would be perfect.

4929. The air used to be tested by the medical officer with a solution of baryta water, and reported upon by him; for what purpose was that?—For estimating the carbonic acid in the air, I should think.

4930. It had this effect: that it turned milky if the air was not pure, and this was tested at the mouth of the machine where the air was being drawn through the ship to the spot where the engine was?—Quite so.

4931. Was it used in the arctic expedition?—Yes, they tested the carbonic acid in that way.

4932. Could you suggest any way in which the atmosphere might be tested more perfectly on the lower deck with the view of requiring better ventilation?—I think the usual way by volumetric examination, the lime-water having been subjected to the action of a certain given portion of the air in the space would take up the carbonic acid, and then the alkalinity might be tested afterwards, showing the exact amount. It can be very nicely estimated in that way. It is now very generally admitted that the amount of carbonic acid gives a very good index of the other impurities that are coincident. Besides carbonic acid, of course you have other matters in the space, but the estimation of the amount of car-

bonic acid would give, as it were, an index of the amount of general impurity.

4933. (*Dr. Fraser.*) Pettenkofer's method is the usual one, is it not?—I think so; it is a very general one adopted on board ship.

4934. (*Admiral Inglefield.*) Did you give any recommendations on the sailing of the arctic expedition with reference to hygienic principles?—I was never consulted on the matter.

4935. Does anything suggest itself to you with reference to the present inquiry which has not been elicited by the remarks which have been made, or the questions which have been put to you?—I was only thinking in what form the lime juice might be manufactured, so as to diminish the bulk, obviate any inconvenience from freezing, and be equally effective; and I have made some experiments in this way. I find that the lime juice extract is perfectly soluble, even when dried as much as possible. It is incapable of being perfectly dried; but dried as far as possible without charring, and carrying the matter too far, it is then perfectly soluble in cold water.

4936. At what temperature?—Freezing. Ordinary lime juice, when unfortified, will freeze at about + 25°, and fortified lime juice (of course, in proportion to the amount of spirits, ordinarily with 10 per cent. of spirits 40 over proof) will freeze at about + 15°. If you add a greater proportion of spirits, you will stop the freezing altogether, and certainly obviate any possibility of breaking the bottles.

4937. Would it increase its bulk much?—The increase of bulk is comparatively little. In a cylindrical bottle it would be likely to burst, but by having conical bottles or a slight increase in the diameter from below upwards, the freezing might happen with an increase of bulk, but at the same time without fracturing the bottle.

4938. You have been aiming to make a lozenge or capsule, I believe; have you succeeded in producing it?—I had made the formulæ for lozenges before the idea was mentioned by Sir George Nares. One was synthetical of the composition of lime juice, and the other was a still better one, by the concentration of the juice, and mixing simple sugar with it. In that case it is very nice; I have some here as a sample (*producing the same*).

4939. What quantity do these lozenges contain?—These are not so concentrated as they might be. They are very agreeable; they are lemon drops, in fact, the separate ration of sugar being unnecessary.

4940. What quantity is contained in them?—One ounce of these is equivalent to one ounce of lime-juice, with the ration of sugar, but I have had them made more concentrated, so that four of them would be equal to an ounce of lime juice. Lime juice may be reduced to at least one-tenth of its bulk or more without altering its chemical composition in the slightest. I have submitted the thing to analysis after having reduced it to this bulk, and I have some bottles with the lime juice reduced still further.

4941. How would these remain in the arctic regions?—Bottled in this state, perfectly; there is no chance of any humidity affecting them.

4942. This is the result, is it not, of experiments which you have made bearing upon the question which we have before us?—Certainly.

4943. Do you consider that the arctic expedition might be supplied with lozenges in this form, and that the men might carry with them a sufficient quantity?—Yes, each man might carry his own allowance for any number of days, in a very small bag. But there is the responsibility of trusting to that which has not been tried. We have still that difficulty, and I say that that warrants a trial with a reserve of lime-juice, and then no blame could be attached to the experiment. I am quite satisfied myself about their efficiency.

4944. Four of these lozenges, you say, are actually equal to one ounce of lime juice?—Yes; which is the

ration. This has an advantage over the synthetical lozenge in really containing all the citric, all the malic, all the tartaric acids, all the phosphorus, all the potash, and, in fact, the original constitution of the lime-juice unaltered; it was analysed again, and found not to have lost any of the vegetable acidity.

4945. (*Dr. Fraser.*) By the synthetical lozenge you mean a lozenge with an equivalent quantity of citric acid?—Yes.

4946. (*Admiral Inglefield.*) These could be made with comparative ease, and you look upon them yourself as a success?—Yes; they were made for me by Mr. Cooper, of Oxford-street, who is a professional lozenge maker. He is the patentee of the effervescent-lozenge, which is an exceedingly nice preparation. There is no gum mixed with them, but simply sugar; they are the original juice reduced by simple concentration in a water-bath.

4947. (*Dr. Fraser.*) I have had some experiments made with the extract also, by mixing extract with the requisite quantity of sugar, and I found that the sugar did undergo some change, and become solid; is that your experience?—Yes; and I think that an advantage.

4948. It becomes less sweet, because the sugar is changed?—Yes; there may be some change in that direction. The fluid might be reduced to one-tenth of its bulk, and then fortified with an equal proportion of spirits, and in that case mixing up 10 parts of water would make it fortified lime juice of the ordinary strength; consequently it would be 10 times the normal strength; and 1 ounce would be equivalent to 10 ounces, or 10 rations.

4949. (*The Chairman.*) At what temperature would it freeze, or would it be exempt from freezing?—With spirit it would be more exempt from freezing, if you have an equal bulk of spirit, one-half the bulk spirits, which would be rather more reasonable, it would be practically impossible to freeze it, and it would be preserved by the spirit as well; so that it would answer two purposes: to prevent freezing, and also to preserve the composition of the fluid itself.

4950. Then I understand that the two modes which you have just described to us of carrying

lime-juice would admit of its being conveniently used under temperatures incident to the spring journeys from the "Alert"?—Yes.

4951. May I assume that scurvy is a blood disease, caused by the want or deficiency of fresh vegetable food?—Yes.

4952. And that there is no other cause of scurvy; cold, fatigue, malaria, syphilis, &c., may aggravate the malady, but cold cannot alone produce it?—Quite so.

4953. Fresh vegetables and fruit prevent scurvy, and also alone can cure it?—Yes.

4954. Assuming that a daily allowance of lime juice could have been administered to the sledge parties of the recent arctic expedition, are you of opinion that the outbreak of scurvy would have been delayed?—It would have been averted altogether.

4955. In such a case what daily allowance would you recommend?—The daily allowance used in the ship diet would answer; that was one ounce daily, but in experimental cases more than that has been administered; for instance, two or three ounces a day were tried in special cases, but as a prophylactic I should say one ounce daily could be used, and in the case of scorbutic symptoms appearing, it might be increased.

4956. In the month previous to the departure of the sledge parties a double allowance of lime juice was issued on board the ship; do you consider that that was an advantageous course to pursue?—I should think it was unnecessary. I should not adopt it unless there was evidence of its necessity; as a prophylactic an ounce a day seems to answer very well. To do that would be adopting the principle that if one pill is good what must a box be. Jack would consume a box of Morrison's pills very readily upon that ground. I think that we need not exceed the dose of one ounce as a prophylactic, which would be equivalent to 30 grains of citric acid per day.

4957. The idea, no doubt, was that the men would have been to a certain extent fortified by this double allowance, but you do not agree with that idea?—No, I do not think it necessary.

The witness withdrew.

FRANCIS S. B. F. DE CHAUMONT, ESQ., M.D., Surgeon-Major, examined.

4958. (*The Chairman.*) You occupy the position of Professor of Military Hygiene in the Army Medical School at Netley?—I do.

4959. (*Dr. Fraser.*) You have, in connection with your position, had occasion to study the question of scurvy, no doubt?—Yes, as a part of my course of hygiene.

4960. I understand that besides this independent study you have been brought into personal contact with the disease, and have had opportunities of observing it?—Yes, during the Crimean war, and I have also seen cases in Scotland.

4961. Can you give us, as briefly as possible, the conditions in which the scurvy occurred in the Crimean war, in the first place?—What I saw there was chiefly the results at Scutari; I was not in the campaign in Bulgaria. During the first winter I was in the hospitals at Scutari, and we received there a large number of men suffering from scurvy in various forms, but chiefly in the form of scorbutic dysentery; and looking to the history of my own and other regiments, which of course I studied a little, the scurvy evidently arose whenever fresh vegetable food became deficient. Even as late as the spring of 1856 I remember that some cases of scurvy began to show themselves in our regiments, although the war had ceased by that time, which I connect with the continuous issue of salt rations for about a fortnight, and also with a deficiency of fresh vegetables, of which there were very few to be had, and they were very dear. The men had rations of preserved

potatoes, so far as I can remember, but I am not sure whether they were continuous or not.

4962. Was there much scurvy in the Crimean war?—There was a good deal.

4963. Not limited to the British troops, I think?—The French troops suffered a great deal more. In the winter of 1855 and spring of 1856 the French troops suffered to a very great extent indeed; but they were extremely badly fed; they hardly got fresh meat at all, so far as I could learn, and the fresh vegetables were very short indeed.

4964. The vegetable food, such as they had, I think was chiefly rice, was it not?—I believe it was, and they scoured the fields for dandelion and other things that they could make salads or soup with.

4965. That was rather an interesting outbreak in its etiology, was it not?—Yes. There is one point I would refer to with regard to the Crimean war, which was interesting, and that is that the scurvy appears to have broken out in Bulgaria, and to have been considerably arrested after landing in the Crimea, on account of the troops getting access to grapes and vegetables in the gardens and vineyards there.

4966. Referring to the former instance which you gave us, did scurvy occur in the French troops in the winter of 1854–55, do you remember?—I think it did, but nothing to the extent that it did in the second winter.

4967. After the winter of 1854–55, do you know, if in the spring, on account of the quantity of

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dandelions to which you have referred, the cases which had occurred that winter greatly diminished?—I believe they did.

4968. Are you aware, further, that in the summer of 1855, the sun having become hot, and vegetation having diminished, the supply of dandelions likewise ceased, and the scurvy made its reappearance?—I cannot be quite certain at present whether that was the case or not with the French troops.

4969. Do you know that in the Crimea scurvy occurred during the hot weather?—Yes, it certainly did.

4970. With reference to your Scotch experience, can you tell us shortly what that was?—It was confined to cases that I remember seeing as a student in the infirmary in Edinburgh. From time to time cases used to be brought in to Mr. Syme for clinical lectures, where men were suffering from ulcers of a scorbutic character. Their limbs were covered with red blotches, and the history of those men was simply that they had had insufficient food in every way. They had apparently lived upon nothing but porridge or tea and bread, without any succulent vegetable, so far as we could understand. But at that time the idea was that, following Sir Robert Christison's view, it was the want of albuminous food that was the cause of it, and those men were treated with milk by Mr. Syme, and they recovered. At the same time it must be said that they had the hospital diet, which of course included a properly arranged diet as far as could be managed.

4971. It included broth, did it not?—Yes; broth with vegetables, and potatoes.

4972. You saw, therefore, cases, and had opportunities of studying them in Scotland and likewise in the Crimea?—Yes.

4973. Can you tell us generally were there any broad distinctions between the symptoms manifested in Scotland and in the Crimea, or do you think that they were quite the same?—I do not think that there was any broad distinction. They appeared to be the same disease. The only point that seemed special was that the disease appeared to affect the bowels very remarkably (at any rate in the first part of the Crimean war), to cause dysentery, whereas I do not remember that in Scotland that was a special feature of the disease.

4974. Was any fault to be found with the water supply in the Crimea, or any other condition that might account for the bowel complaint, do you remember?—None that I know of.

4975. This represents your personal observation?—Entirely.

4976. From your personal observation, and from your knowledge of the history of scurvy, can you shortly tell us your views as to its etiology?—I think that the principal, if not the only cause of scurvy, is the want of fresh vegetable food, or at any rate of some of the constituents which compose fresh vegetable food. It is quite true that there are apparently some cases which have been due to other causes, such as the want of albuminous food, which have apparently been cured by the administration of albuminous food, but I do not know of any that have really stood the test of a thorough investigation, wherever that was possible. In all those cases there was an absence of vegetable food as well. It is quite possible and likely that scurvy may in some rare cases be caused by error in diet in some other direction; but the recorded cases are certainly very few.

4977. Do you consider that the mass of evidence points distinctly to the conclusion that it is a disease caused by the absence of vegetable food, or of some constituents of fresh vegetables?—Yes.

4978. Can you give any opinion as to the vegetable constituents, the absence of which is the probable cause of scurvy?—I think that there seems very little doubt that it is the vegetable acids, such as the citric acid, the tartaric, the malic, the lactic, acetic, &c., and that the absence of those produces scurvy.

4979. And because lime juice or lemon juice contains a large quantity of those acids it has been introduced, has it not, to supply the want of fresh vegetable food?—It has.

4980. That, in short, is the theory of its use?—It is. Other theories have been advanced with regard to the efficacy of potash and phosphoric acid in lime juice, but the general feeling is that the amount is so extremely small, that it could hardly be possible that that could be the case. In addition to that salts of potash have, I believe, been tried in various instances ineffectually.

4981. The salts of potash, I think, do not amount to so much as a grain in an ounce, do they?—Very considerably under a grain in an ounce of lime juice. The phosphoric acid is a mere trace.

4982. Whereas the citric acid amounts to somewhere between 30 and 40 grains, does it not?—Yes, sometimes even going above 40 grains. The last sample that we analysed, and a sample which actually did come from the ships in question, gave between 39 and 40 grains.

4983. And potash is present in many foods, is it not, in a larger quantity than in lime juice?—Yes, in many; in cocoa, for instance, there is a great deal of potash.

4984. I think those foods have not gained any special antiscorbutic reputation?—No.

4985. You examined, you have just said, the lime juice which was supplied to the recent expedition, and the result is that there were from 39 to 40 grains of citric acid in it?—Yes, 39·2, if I remember rightly, was the average. Dr. Macdonald and I examined it together.

4986. Did you make any experiments as to the effect of low temperature upon that lime juice?—Not upon that identical sample, because it came a little too late. We only got it two days ago, and had not time to freeze it; but one of the other samples sent down from the naval stores to us we froze, and carried it down to as low a temperature as we could.

4987. What was the result of those experiments so far as the retention of the virtues of the lime juice is concerned?—There seemed to be no difference. The only difference was that the fortified lime juice took a lower temperature to freeze than the unfortified; but when they were melted the result of the analysis for acids was exactly the same as before; there was no difference whatever.

4988. What was the appearance of the frozen lime juice?—It was a pale colour, very like an ordinary ice, slightly tinted with yellow.

4989. It was a homogeneous substance apparently?—Entirely, and it redissolved without any turbidity.

4990. There was no accumulation of citric acid or other substance in one portion of the solidified mass, was there?—Not as far as we could see.

4991. Did you test the lime juice to ascertain the degree of acidity after subjecting it to freezing?—Yes, we did.

4992. And what was the result?—It was the same as before; there was no alteration.

4993. You have already told us, I think, that your opinion is that scurvy is a dietetic disease?—Entirely so.

4994. What is your notion as to the influence of such conditions as darkness, extreme cold, privation, exposure to damp, and great fatigue in the causation of the disease?—I think that they would all go some considerable length in favouring the development and production of the disease, but without the master cause, the want of fresh vegetable material, I do not think that they would be capable of producing it.

4995. They may be regarded as predisposing causes, therefore, and the absence of fresh vegetable material as the specific exciting cause; is that your opinion?—Exactly so.

4996. Scurvy being in your opinion a dietetic disease, it would be interesting to obtain your notions regarding the scale of dietary used in this expedition. I believe the subject of dietetics is one to which you have devoted very great attention?—Yes, it is.

4997. The subjects of food values and scales of diet, and of the relation between the food and the work done in the recent expedition have been carefully considered by you?—They have.

4998. In the first place, with regard to the scale of victualling on board the ships in the recent expedition, what is your general opinion respecting its suitability for men in the condition of the men confined on board ship during the arctic winter?—It seems to me, looking at the ship's diet, that it is a

very good diet indeed, and quite sufficient for the purpose.

4999. Have you made any estimation of the food principles in this diet; and if you have, can you give us the results generally?—Yes. I may mention with regard to the diets that of course it is not absolutely possible to get the exact values in each case, because they must vary, and also in some instances we have not the data. As regards those ships' diet, however, I think we can get tolerably close to the estimate. The only question, perhaps, is as to how much fat there is in the diet. I do not know that any positive evidence is extant that could be used with certainty on the subject of the amount of fat in corned pork and beef, but I have estimated it as well as I could. I shall first mention the ship's diet.

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SHIP DIET.

Constituent.	Oz. water free.	Ratios : albuminates = 1·00.
Albuminates.....	4·76	1·00
Fats	4·18	0·88
Carbohydrates	16·84	3·54
Salts (mineral).....	1·66	0·35
Total	27·44	

Nitrogen = 328·5 grains.		
Carbon (total)	= 5860·0	„
		Ratio to total.
Do. from albuminates	1145	19·54
Do. „ fats	1445	24·62
Do. „ carbohydrates.....	3270	55·84
Total	5860	100·00

Nitrogen to carbon = 1 : 17·8.

Potential Energy in Foot-tons.

		Ratio to total.
From albuminates	828	18·28
„ fats.....	1173	25·97
„ carbohydrates	2526	55·75
Total.....	4527	100·00

Calculation of Productive Work.

Total potential energy	4527	
Minimum for existence	2550	
Available for productive work	1977	which would yield about
	368	of productive work.

Total nitrogen.....	328·5 grains	| Allowing half-a-grain of nitrogen per ten for the first 300 foot-tons, 0·7 per ton for the next 150, and so on; this would
Minimum per existence	172·0 „	
Available for work.....	156·5 „	

admit of about 309 foot-tons of productive work.

Foot-tons as calculated above	368
Total	2)677

Mean 338·5 or, in round numbers, 340 foot-tons of work,

which could be done without loss of weight, on the above diet, provided it were entirely assimilated to the best advantage.

Another point with regard to the ration is that it seems to be one well calculated to keep off scurvy, containing as it does an ounce of lime juice and an ounce of pickles daily; and the average ration of four ounces of preserved vegetables, besides fruit, which I presume is bottled fruit, and also dried fruit in the dough puddings, in addition to the minor points of

celery seed, compressed vegetables, and so on, which are only in small quantities comparatively speaking; and also vinegar which is put down to be used in cooking as required.

5000. Will you now proceed to the sledge ration?—The sledge ration, so far as the actual quantity of food goes, appears to be a good one.

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SLEDGE DIET.

Constituents.	Oz. water free.	Ratios : albuminates = 1·00.
Albuminates.....	7·99	1·00
Fats	11·65	1·43
Carbohydrates	15·22	1·90
Salts (mineral).....	0·79	0·10
Total.....	35·65	
Nitrogen = 552 grains.		Carbon = 8842 grains.
Nitrogen to carbon = 1 : 16·2 grains.		

	Grains.	Ratio to total.
Carbon from albuminates	1863	21·1
„ fats.....	4027	45·5
„ carbohydrates	2952	33·4
Total (as above)	8842	100·0

Potential Energy in Foot-tons.

	Quantity.	Ratio to total.
From albuminates	1391	20·0
„ fats.....	3275	47·1
„ carbohydrates	2282	32·9
Total.....	6948	100·0

Calculation of Productive Work.

Total potential energy	6948
Minimum for existence.....	2550
Available for work	4398
This would yield about.....	600 foot-tons of productive work.
Total nitrogen	552 grains.
Minimum for existence.....	178
Available for work	374
This would admit of about	570 foot-tons of productive work.
Total calculated above	600
	2)1170

Total (mean)..... 585 foot-tons of productive work, which could be done without loss of weight on the above diet, provided it were entirely assimilated to the best advantage.

With regard to this diet the quantity is certainly ample, the only point is that some of the constituents seem rather in excess, and especially the amount of nitrogen. It seems hardly possible that the body could deal with such a quantity as that. The probability is that, if it was all taken into the system, a good deal of it passed out unchanged.

5001. Then a loss would result, would it not? —Yes, considerable loss below what is calculated here. Then with regard to the diet as an anti-scorbutic diet, it had been deprived of everything that would prevent scurvy with the exception of two ounces of preserved potatoes. The lime juice had been cut off, the pickles had been cut off, and the preserved vegetables and the compressed vegetables, excepting preserved potato as shown here, were cut off. I believe that some of the pemmican was made up with dried fruits, if I mistake not.*

5002. The evidence was that there was sugar in some of the pemmican carried by the sledge parties, but it would rather be an advantage, would it not, to have sugar in the place of some of the nitrogen? —It would.

5003. It would improve the dietary, in fact?—Yes, it would. In fact so far as one can gather from the scales that are printed, everything has been removed from the ship diet that was antiscorbutic with the exception of two ounces of preserved potato. There is also of course the additional disadvantage in the want of soft bread which was issued on board ship.

5004. With reference to the quantity of preserved potato in the sledge party dietary, putting aside altogether the fact of the occurrence of scurvy while this dietary was being used, do you think that this quantity of preserved potato was insufficient to ward off scurvy?—I think it was. There seems to be considerable reason for doubt as to whether the preserved potato is really equal, proportionately, to the fresh potato. There seem to be strong chances that the potato during the process of preparation, especially during the process required to make it edible, would lose a good deal of the soluble or organic salts out of the substance of it, namely, the citrates, the tartrates, and the malates, which are all present in more or less quantity in the raw potato.†

* For analyses of the samples of pemmican, see Appendix, No. 23.

† For analysis of the preserved potato, see Appendix, No. 23.

5005. Then it does not greatly surprise you, does it it, that with this diet scurvy has occurred?—Not at all.

5006. In reference to any estimate that you could form of the amount of work done by the sledge parties subsisting on this diet, can you tell us if it was in any respects excessive when you take into consideration the productive work that the diet represents; or can you give us any details upon that point?—With regard to that point, I have endeavoured to calculate out the work done, but you will remember that I present this with all due reserve, because it is a very difficult thing to calculate out in the absence of positive data, and therefore a good many points have to be estimated; but taking the two journeys of which the details are given, namely, Commander Markham's northern journey and Lieutenant Aldrich's journey, I have tried to calculate them out with the following results:—Commander Markham records that he did a total distance out and home of 601 miles,* and that the distance made good north and south, at least from and to the ship, was 166 miles. In the description of the journey I am not quite certain that my interpretation of the report is the correct one, but I apprehend that the distance "made good" of 166 miles is the actual distance over which the sledges were dragged. Then that would be the distance on which we should have to calculate the work done in dragging the sledges; and in addition to that we must add on the total distance of 601 miles marched by the men themselves. To work out this we find it stated that the weight at starting per man in Commander Markham's expedition was 236½ lbs. of sledge weight; and that on a subsequent part of the expedition, namely, starting from Cape Joseph Henry I think it was, they were at one time weighted to 405 lbs. per man. This of course would not be for a continuance; I have not included that in my calculation; I merely mention it because it is put in the return. I take it, however, that if we adopt the starting weight, 236½ lbs., allowing for all accidents, that would be a fair enough average. The

total length of time was 72 days. Then the difficult part of the calculation is to estimate at how much we ought to calculate the resistance of the weights dragged; I have put it down at one-sixth of the weight. According to existing tables taken from Molesworth's engineering formulae, the resistance in pounds per ton on roads with wheeled conveyances, exclusive of gravity, gives for soft sand and gravelly ground, which is the worst, 210 lbs. per ton, or about one-tenth of resistance. Considering the very arduous nature of the journey that these men undertook under Commander Markham, I think that if we consider the resistance to amount to one-sixth it will not be an over-estimate. According to that rate the total amount of work done in 72 days in dragging the sledges per man amounted to 15,432 foot-tons. Then with regard to the work done by the men marching the total distance, I have assumed that each man in ordinary clothing would weigh about 160 lbs., which I think is a fair average, and that he would probably weigh 200 lbs. in his arctic dress with everything that he carried, and I think that that is not an over-estimate. Then I have allowed the usual co-efficient $\frac{1}{3}$ th for resistance, which is that for walking at a pace of three miles an hour upon an ordinary road. Of course in the case of this expedition the velocity was much less, and therefore the resistance would be theoretically less than upon an ordinary road. But I think it would quite equal $\frac{1}{6}$ th considering the circumstances they had to work under. Then that would give us for the 72 days 14,183 foot-tons, or a total of 29,615, or per diem, 411 foot-tons. I think the probable maximum that a man could do for a length of time of that sort of work would be 450 foot-tons in round numbers. The estimate of 411 foot-tons of course does not take into account the labour of road-making, which must have been very considerable, and would add on to the work done, and I think bring it up to probably at least 450. The following tabular statement will show the results in a convenient form:—

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COMMANDER MARKHAM'S SLEDGE JOURNEY.

A. Distance made good to and from the ship through which the sledges were dragged	166 statute miles.
B. Total number of miles walked by the men, including the distance made good	601 .. "
Weight of sledge per man at starting	236½ lbs.
(Adopted as the mean of the journey for distance A.)	
Weight of man, clothing, &c., and all personally carried	200 .. "
(Adopted as weight for distance B.)	
Coefficient of traction adopted for A	⅙ .. "
(N.B.—The coefficient for wheeled conveyances on soft sand and gravelly ground is ⅓; considering the character of the ground traversed in this case ⅙ is not excessive.)	
Coefficient of traction for B	⅓ .. "
(N.B.—This is the coefficient for 3 miles per hour on level ground; in the present case the velocity was less, but the badness of the ground would fully make up for it.)	
Total length of time the journey lasted	72 days.
Amount of work done (per man).	
Total.	
Per day.	
A. Sledge dragging :—236½ lbs. through 166 miles for 72 days at ⅙	15432
B. Walking :—200 lbs. through 601 miles for 72 days at ⅓	14183
<hr/>	
Total per man	29615
<hr/>	
	411 .. "

This, with the additional labour of road-making, would probably be raised to 450 or 480 foot tons,—perhaps even more.

(For corrected estimate, and for remarks by Captain Markham, see Appendix 24.)

5007. (*The Chairman.*) Do you say that you have added 601 to the 166?—I added that for the distance the men had walked through themselves. For the 166 I calculated out merely the weight of the sledge dragged. Then to that must be added the weight of the man himself, walking through the total

number of miles that he walked. That would include, of course, the 166 miles during which he carried his own weight as well as the sledge, and then the additional miles, backwards and forwards, that he would walk and carry his own weight alone. This amount comes up, very nearly at least, to what

* The distance was subsequently given as 605 miles.

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we calculate the probable total labour done at about 450 foot-tons, which I have reason to think was likely to be the case if we allow for the labour of road-making. It comes within 90 foot-tons of the total productive force calculated from the potential energy of the food. This is, of course, on the supposition that this large amount of food was thoroughly digested, assimilated, and dealt with to the greatest advantage.

5008. (*Dr. Fraser.*) From what you have said with regard to the sledge rations and the sledge work, the men apparently did work up to the total capacity that you could expect from them, and up to the total productive force of the food which they took?—They certainly did. Allow me now to give the calculations made with regard to Lieutenant Aldrich's journey. In that case the distances were somewhat greater. I presume that the reason of this was the

better condition of the road that they had to traverse, because they do not appear, as far as I can gather, to have had so much road-making and cutting, and so on. The distance made good was 509 miles, and the total traversed 708 miles in 84 days, the amount per man of sledge weight at starting being 241 lbs. In this case, as the road appears to have been very much better than the other, I thought that it would hardly be fair to assume the resistance as more than $\frac{1}{10}$ th of the sledge weight. However, even at that rate the amount is very great. The sledge work I calculate, therefore, per man would be for 84 days 28,950 foot-tons, and that, the men themselves walking, allowing 200 lbs. weight per man, would give 16,710 foot-tons; the total for 84 days being 45,660, and this per diem would give 544 foot-tons, or quite up to the calculated productive force to be got out of the food.

LIEUTENANT ALDRICH'S JOURNEY.

A. Distance made good to and from the ship, through which the sledges were dragged	509 statute miles.
B. Total number of miles walked by the men, including the distance made good	708 "
Weight of sledge per man at starting	241 lbs. "
(Adopted as the mean of the journey for distance A.)	
Weight of man, clothing, and all personally carried.	200 "
(Adopted as mean for distance B.)	
Coefficient of traction adopted for A	$\frac{1}{10}$ "
(N.B.—This is less than in Markham's journey, but the road was apparently better.)	
Coefficient of traction for B	$\frac{1}{20}$ "
(N.B.—This is perhaps a little over-estimated when compared with the heavier ground in Markham's journey.)	
Total length of time the journey lasted	84 days.
Amount of work done (per man).	
Total.	
Per day.	
A. Sledge dragging:—241 lbs. through 509 miles for 84 days at $\frac{1}{10}$	28950
B. Walking:—200 lbs. through 708 miles for 84 days at $\frac{1}{20}$	16710
<hr/>	
Total per man (foot tons)	45660
<hr/>	
	544

This is apparently greater than in Markham's journey, but the nature of the work on the latter was in reality probably greater. The above is probably a full estimate of what was done in this case.

(For corrected estimate, and for remarks by Commander Aldrich, see Appendix 24.)

5009. (*Dr. Fraser.*) The work, therefore was harder in this latter expedition?—The work appears to have been harder; but then in Commander Markham's expedition I have not estimated the road work positively. It is merely a rough estimate; the work may possibly have been equally hard in the two cases, although it was probably harder on Commander Markham's expedition. The roughness of the road caused the exertion to be greater on account of the sudden pulls which require additional strength, and would, of course, tell.

5010. Then your estimate is rather increased than diminished by that?—Yes, decidedly. Sudden strains are always much more exhausting than continuous labour at a moderate rate. You will observe that the first scurvy symptoms were seen in Commander Markham's expedition.

5011. (*The Chairman.*) Have you taken into account that the weight of the sledges naturally diminished day by day as they ate their provisions, and they also put provisions in depôts at different places?—Yes; but at the same time the effective working hands were also being diminished.

5012. Of course the effective working hands came down to one or two at last?—Yes; so that I have considered that point, and it seemed to me so difficult to work out the details from data given individually that I thought if we adopted the average weight at starting it would allow for the diminution of weight, as that would be equalised by the diminution of the effective dragging power.

5013. They had two boats, but they left their boats behind at last?—Yes.

5014. Of course the sledges when they returned to Cape Joseph Henry were nearly empty, except the sick men that they were carrying?—Yes. This would require considerable correction if we had sufficient data.

5015. (*Dr. Fraser.*) In both the expeditions of which you have gone into details respecting the work, calculated so far as the data will permit, it was very nearly up to the productive force calculated to be evolved by the food taken?—Very nearly.

5016. So that if the total food represented in the dietary were not consumed, sufficient nourishment could not have been taken for the work done?—No, certainly not.

5017. That being so, it would be all the more necessary, would it not, that some antiscorbutic should have been represented in larger quantities in this dietary?—Certainly.

5018. The great labour—nearly up to the extreme capability of the men and to the maximum amount of productive work calculated to be evolved from the food taken—no doubt represents a condition favourable to the development of scurvy or of any other disease?—Yes.

5019. But at the same time this great amount of work, and the other conditions that have been referred to, would not at all account, would they, for the production of the scurvy?—No, certainly not, without the absence of antiscorbutics.

5020. Do you know if work perhaps as great has been done by men under somewhat similar conditions without the occurrence of scurvy?—I have hardly had time to refresh my memory on the subject of arctic voyages on previous occasions; but, as far as I remember, in the M'Clure expeditions, they were free from scurvy for a very considerable time, although they underwent considerable hardships and went through a great deal of work.

5021. But in other conditions, do you think that as much work has been done without scurvy being produced?—Unquestionably. There are many instances in this country of work to the extent of quite 700 foot-tons being done continuously without scurvy being produced. Of course they are exceptionally powerful men who can do this; and the amount of work which would be gone through, for instance, in the tropics by a native Indian in India in the way of walking would be quite equal to the work, calculated out by the usual formulæ, gone through upon this occasion, though, of course, the conditions are very different.

5022. Taking all the facts that you are aware of into account, does it occur to you that anything in the history of this epidemic is at all remarkable?—It strikes me, in the first place, that it is remarkable that the sledge parties should not have been supplied with antiscorbutics. I have not seen a copy of the instructions from the Medical Director-General upon the subject, but with the experience of former expeditions, I should have thought that especial care would have been taken that that should be done. Another point that struck me on reading over the accounts was the surprise that those in the sledge expeditions seemed to have felt at the appearance of the disease when it was once recognised. It was evident that it was sometime before the disease was actually recognised; and of course unless one had been already to a certain extent familiar with its symptoms, it is quite possible that even the medical men might not have at once recognised the symptoms. But it seems to me odd, that any surprise should have been felt under the circumstances that scurvy should have broken out on the sledge expeditions.

5023. You think, therefore, that there is nothing remarkable in so far as the causation of this outbreak is concerned?—It seems to me quite simple that the scurvy actually broke out in each instance after the men were exposed for a certain time to the conditions which, I think, are the cause of the disease—the want of antiscorbutics. We find in Commander Markham's journal that it was 11 days before the first record of scurvy symptoms was entered; in Lieutenant Beaumont's journal, 16 days; and in Lieutenant Aldrich's, 27 days.

5024. There was nothing remarkable, so far as your knowledge of the subject goes, in the production of this outbreak?—No, there seems to have been nothing remarkable.

5025. You have, I know, very carefully studied the subject of ventilation?—I have.

5026. You have made a great many original observations, have you not, on that subject?—Yes.

5027. Can you tell us, generally, how much fresh air is required to be supplied to a man per hour in order to maintain a pure atmosphere?—Not less than 3,000 cubic feet, and indeed for a full-grown adult man more nearly 3,500. This is chiefly with reference to dormitories when men are in a state of repose. When in active occupation each man would require 4,000 or 5,000 feet at least to keep the air in a state of purity; that is to say, to keep down the respiratory impurity, as estimated by the carbonic acid, down to $\cdot 2$ of a foot per thousand.

5028. In order to maintain a pure atmosphere, it is necessary, is it not, in inhabited and inclosed spaces to renew the air?—Undoubtedly.

5029. Can you tell us how often it is convenient, in a temperate climate such as in this country, to renew the air in a chamber?—Three times an hour

is about the most frequent that can be done conveniently.

5030. If it were done six times per hour, what would you expect as the result?—There would be too great a draught, and probably too great a diminution of the temperature. I am speaking of course of the incoming air not warmed, but at the ordinary outside temperature.

5031. I would ask you to make a very simple calculation on the data which you have given us with the addition of this; that you have a chamber in which the space per head is 120 cubic feet: how often would the air require to be renewed in such a space to maintain a sufficient purity?—On the minimum calculation of 3,000 cubic feet, it would be required to be renewed 25 times.

5032. Do you think that an impossible frequency in this country during the winter months?—Quite impossible; it could not be borne.

5033. If the temperature were considerably below zero, do you think it would be still further impossible?—Absolutely impossible.

5034. I suppose, however, if the air from the outside were heated before its distribution in the closed chamber, it might be renewed more frequently than otherwise?—A great deal more.

5035. Do you think that even 25 times an hour might then be possible?—It is difficult to say that it would not be possible, for if there was little or no difference between the incoming air and the outgoing air, the draught would not be perceptible.

5036. It does not strike you that even such a frequent renewal is utterly impossible?—Not utterly impossible. It would depend, of course, upon the temperature entirely; but it is a question of theory.

5037. In a confined space in the arctic regions where each occupant has about 120 cubic feet, and where there are no means of heating the air admitted from the outside, what would you expect would be the condition of the air with respect to its purity?—I should think it would be extremely impure.

5038. We have some analyses referring to that air which naturally vary somewhat. I think, however, the variations are included between $\cdot 4$ and $\cdot 5$ per cent. of carbonic acid in the air; does that represent to your mind a very impure atmosphere?—An extremely impure atmosphere; that is equal to five volumes in a thousand.

5039. While, as you have already told us, the maximum quantity of carbonic acid permissible is something over half a volume per thousand?—Yes.

5040. I should further like to ask you if you are aware of any analysis having been made of the outside air in the arctic regions?—No, I cannot call any to mind at this moment.

5041. Or in any cold regions, such as the summits of mountains?—Dr. Angus Smith and others have made analyses, with the result of finding that there was very little difference in the amount of carbonic acid in the one case and in the other.

5042. Very little difference on the top of a mountain and in the middle of a city you mean?—Yes, very little difference under favourable circumstances. Of course, in the middle of a city on a still damp day, it would be very different; but I may mention that I made myself this last year, in the month of August, a number of analyses in connection with an inquiry at St. Mary's Hospital, Paddington, and out of an average of some 28 analyses of air taken from the streets round and on the top of the hospital, and so on, the mean came to exactly $\cdot 4$ per thousand, the usually accepted mean.

5043. If the air before it is admitted into a chamber were heated, you might thereby effect not only a more frequent renewal, but also, of course, a more complete removal of the vapour, might you not?—Unquestionably.

5044. And to some extent, at any rate, obviate the great inconvenience in the arctic ships of condensation of moisture?—Yes, the capacity for vapour

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increasing rapidly with the temperature. I would just wish to give the amount of air calculated out from the data of five volumes per thousand. Under these circumstances the inmates of the ship could not have had on an average more than 160 cubic feet of fresh air per hour, instead of which they ought to have had at least 3,000 on the lowest calculation. I would make another remark with regard to the renewal of air, and point out that, for instance, on a moderately fine day in the external air the air is renewed quite as often in many cases as 25 times in the hour without any inconvenience being felt, the temperature remaining of course the same.

5045. (*Dr. Donnet.*) Can you tell me what is the cubic space allotted to each man in barracks?—The regulation space is 600 cubic feet net.

5046. What is it in the military hospitals?—1,200 cubic feet in temperate climates.

5047. Practically, how frequently is this renewal considered necessary?—According to the regulations based on the recommendations of the Barrack Commission the renewal is supposed to take place twice in an hour, but this is quite insufficient. The regulations contemplate that a soldier should get 1,200 cubic feet per hour in barracks and 2,400 feet in hospitals, but I say this is quite insufficient. The truth is, however, that even this moderate result has not been attained except in a few instances.

5048. Can this renewal in hospitals be effected without inconvenience to the patients?—Certainly. A portion of the air, however, I should say, is warmed by Galton's heated chamber.

5049. The northern sledge party under Commander Markham, with which you are well acquainted, left the ship on the 3rd of April, 1876, and 14 days after the first case of scurvy occurred; but the man who was the subject of it left the ship in good health and had taken his lime juice regularly up to the date of departure. As you have given so much care and attention to the details of the men's work and the journey, I would like to ask your opinion upon the causes which occasioned scurvy in this person?—I should think it was the loss of lime juice and the other anti-scorbutics that he had on board ship.

5050. It seems that the scale of diet for the sledge parties was very little different from those used on other sledge journeys, and as information has been afforded to the Committee of sledging parties having gone over 900 miles and occupying about 80 days without lime juice, I have asked this question so as to have your opinion upon the symptoms of scurvy occurring so soon after leaving the ship and under the conditions in which this man left it?—To answer that question fully it would be necessary to have the medical history of the man to begin with and the personal habits of the man.

5051. From information which we were able to obtain from the medical officers, his condition seemed to have been good. He had taken his lime juice up to the day of departure?—There may have been something in the man's circumstances that may have predisposed him and rendered him more susceptible of the disease than the others.

5052. Do you think that any circumstances, such as hard work and absence of light to which they have been subjected for 142 days, may have had some influence in producing this disease in this man?—Most likely in predisposing the man to it. Those are all conditions that are calculated to favour the production of scurvy.

5053. Do you think that the absence of light had any deteriorating effects upon the men's constitution?—Undoubtedly. It would produce anæmia; it would not of itself produce scurvy, but it would unquestionably help the production of it.

5054. You have said in your evidence that the want of fresh vegetables, or the constituents of fresh vegetable food, is a cause of scurvy. Do you know

whether one vegetable possesses qualities superior to another?—Yes, there are certain vegetables, and especially the potato is one, cabbage and the cruciferous vegetables generally, and of course all the succulent fruits, especially those that are acescent, such as the lemon, the lime, and grapes amongst others.

5055. You have said that the French in the Crimea collected dandelion and used it as a salad, and I believe you added that it gave them a certain amount of immunity. What are the virtues to be found in dandelion?—It is a succulent vegetable which probably contains some of the vegetable acids; it also contains a certain extractive material which is supposed to be good for the health. In ordinary times it is a favourite salad in France.

5056. Do you consider lime juice to be the best antiscorbutic that can be provided for ships in long sea voyages?—Yes.

5057. Do you know of any article which would furnish these qualities in an equal degree with the lime juice?—The only article I think would probably be citric acid.

5058. Are you of opinion that citric acid would ward off scurvy?—I think so.

5059. Have you any experience in the use of this acid?—No, not for scurvy, no personal experience; it is merely from hearsay and also from the fact that that is by far the largest constituent of lime-juice, and therefore reasonably to be considered a powerfully active agent.

5060. I believe you are of opinion that the supply of articles of food to the arctic expedition was liberal and in every way adequate to support life?—Yes.

5061. Do you consider the fatty matters supplied in the diet list sufficient?—If my estimates are correct they were sufficient; but the question is whether I have not estimated the fat rather too high, the chief part of that being in the ship's ration in corned pork and in the sledge diet being in the bacon and in the pemmican.

5062. I have put this question as several of the witnesses suggested, as an addition, butter?—Butter certainly would have improved the diet no doubt. It is a valuable thing and easily digested, and is generally eaten, when sometimes pork is not taken willingly; but if the whole of the pork was eaten and assimilated properly, it seems to me that the fat was sufficient.

5063. Have you formed any opinion about this outbreak of scurvy in the late expedition?—I think it was due to the want of antiscorbutics in the sledge parties, helped, no doubt, by the excessive work and the cold and the prolonged darkness.

5064. (*Admiral Inglefield.*) I think you gave the Committee an idea of the quantity of cubic feet of air that was necessary to support a man when at rest. What was the amount which you considered was an essential for keeping a man in good health?—The lowest amount I put at 3,000 cubic feet per hour.

5065. Now the space that is admitted to exist on the lower deck of a ship you made out was 120 cubic feet per man. To change that so that the men should have the proper amount, according to your notion, of cubic feet of air to consume, how many times would it have to be changed in the hour; I think you said 25 times?—Yes.

5066. Now to maintain that, supposing a steam-engine could be employed for pumping out foul air and pumping in fresh air, or admitting it, at what rate must the air travel to do that. We have a way of measuring the number of miles that the wind is travelling; can you give the Committee any idea either in the shape of force or the number of miles of the rate the air must travel to change it as frequently as that?—It would depend upon the size of the aperture through which it was coming.

5067. Supposing it to be an aperture sufficient to admit of its passing freely; I am supposing a free

aperture, such as could be obtained on board ship through a ventilating apparatus?—Through a square foot, for instance, you mean? To deliver 3000 cubic feet per hour, at a velocity of 5 feet per second, you require a sectional area of 24 square inches; that is the sixth of a square foot.

5068. At what rate would it travel?—At the rate of 5 feet a second through the aperture.

5069. That would amount to pretty nearly a good stiff breeze?—That is about three miles per hour; I do not think much more than that.

5070. In any case it would constitute in a dangerous draught for the men to lie in, do you not consider?—It certainly would be too much draught, unless the air were heated. I have now made a calculation, and I find it would be just under three miles and a-half an hour, 3·4 miles.

5071. What process would you recommend by which that ventilation could be kept up, supposing mechanical arrangements were made for the purpose?—I think that an extraction apparatus would be generally more successful than any other.

5072. That, in fact, instead of forcing fresh air down into the sleeping apartment of the men, the foul air should be pumped out, and fresh air allowed to find its way in through proper apertures?—Yes.

5073. And would you recommend that such should be the process in case of another ship being equipped for arctic service?—I think it would be advisable, if proper means be got for heating the air.

5074. Do you know the Sylvester stove?—Yes.

5075. Would it be a fair method, that of drawing air over a Sylvester stove, or the pipes connected with it?—The question is whether it would be sufficient.

5076. Whether it would not abstract the heat too quickly?—Yes.

5077. Is it your opinion that the men sleeping in a cubic space so small compared with what you consider is the proper quantity, thus the seeds of scurvy were first sown in the constitution?—No.

5078. Then in what way do you consider that the dangerous effect would act upon them?—I consider it would produce a deterioration of health, but it would never of itself produce scurvy.

5079. Then other predisposing causes would be required to germinate the seeds, in fact?—Or rather I should say that it would be a predisposing cause, and that an active cause would be necessary in the absence of some constituents of diet.

5080. And what would you look upon as the most active cause producing the scorbutic symptoms?—The absence of vegetable diet, or the constituents of vegetables.

5081. But where lime juice was taken freely, and the men obliged to drink it on the quarter deck, as was the case in these arctic expeditions, where there was every precaution taken, where was the predisposing cause before they started on the journey when no lime-juice was issued?—The predisposing cause consisted first in the foul air they were existing in; and secondly, in the length of time they were deprived of light (those are the two probable chief predisposing causes); and lastly, the extremely low temperatures to which they were exposed.

5082. Do you attribute much to the action on the mind?—A depression of mind certainly is also a cause that would act; the monotony of the life no doubt aiding it.

5083. Then the precautions that you would suggest to prevent the outbreak of scurvy in an arctic expedition would in the first place be a proper amount of cubic space of air to breathe in?—Yes.

5084. And a dry atmosphere, I presume?—Yes, a dry atmosphere.

5085. You impute something to moisture of the atmosphere as a deleterious cause?—Undoubtedly.

5086. And you would recommend an abundance of vegetable food?—Yes.

5087. Cheerful habits you would think important?—Yes.

5088. And a fair proportion of exercise?—Yes, certainly.

5089. And with these you think a man might be preserved through the winter in a condition of health fit to undertake severe work during the spring?—I think so. There is only one point that you have omitted, the sufficient renewal of air.

5090. I mean by an abundance of space either a limited space frequently replaced by pure air, or the space itself being sufficient?—I would make a remark on that point, and that is that I consider, both from theoretical and from practical grounds, that it does not matter how much space a man has to live in; he still requires the same amount of renewal of air, whether he has 1000 feet or 100 feet to live in.

5091. But surely if a man sleeps in the open air, there would require to be no change of the air?—The air is continually being renewed, then.

5092. If a man were put to sleep in a very large room by himself, no mechanical process is necessary to change the air, is it?—Unless you take a space so large that it practically is open air, after the second hour of occupation the difference between a large and a small room disappears altogether.

5093. Then even in one's own bedroom that would be the case?—You should have 3,000 cubic feet of air every hour all night to keep the room in a proper state.

5094. Will that be supplied through the door or the chimney?—No.

5095. You would say a person should have the window open, then, I suppose?—Or have a ventilator.

5096. There are the keyholes and the sides of the door, and the window, where, if you hold a candle, you find the flame in some measure blown; does not that supply the fresh air needed?—Not sufficiently. The only difference between a large and a small space is one of course of great practical importance, and that is the possibility of renewing the air sufficiently often to give the necessary amount of fresh air. Where we have a space of 1000 cubic feet per man, we can easily renew the air three times an hour without discomfort.

5097. And this pure air which passes through the lungs and so purifies the blood keeps the blood in a proper condition, so that it will be more likely to withstand the chances of scorbutic attacks; is not that the way in which it acts?—Yes.

5098. By purifying the blood, providing the blood with oxygen?—Yes, providing the blood with oxygen, and also by preventing the re-breathing of the impure organic matter which has already been got rid of.

5099. Do you attribute much difference to the anti scorbutic qualities of preserved and fresh potatoes?—I think it is very probable that the preserved potato is inferior as an anti scorbutic to fresh potato; of course making due allowance for the proportionate amount of material in each sample.

5100. But the starch in the raw potato is preserved, is it not; and what anti-scorbutic property of the fresh potato is removed by preserving?—The substances that act as anti scorbutics are the vegetable acids, the citric, and tartaric acids, and various others in small quantities, which exist in the fresh potato, and which are probably lost to a certain extent in the process of preparing the dried potato, and also in all probability lost still further in the process of making that dried preparation fit for eating; it requires to be soaked a good deal, and in that way the probability is that a certain amount of the salts would be dissolved out, and therefore the efficacy of the potato as an anti scorbutic weakened.

5101. With reference to the sledge diet, rum and tea were always taken; and we have had evidence before us that the men invariably found tea the most invigorating to travel upon; in fact it was

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the custom, when the service admitted of it, to give them tea at the mid-day meal and rum at night. Have you any opinion as to the administration of rum and tea under extreme exposure and hard work?—I think that tea is decidedly preferable to rum.

5102. As a stimulant and as a corrective?—Yes, as a refreshing beverage. I assisted at a number of experiments made by the late Dr. Parkes, of Netley, on that subject, and I saw the men under experiment, and all who were experimented upon gave it as their opinion that the rum was the worst thing to work upon.

5103. Then would you altogether exclude rum from the diet?—I would not altogether exclude it, but I think that, knowing, as we do, that alcohol acts to a certain extent in lowering the temperature of the body, and that it is a bad thing to work upon, I would certainly put it last in the articles of diet.

5104. Has it occurred to you to make either experiments or inquiries as to the possibility of concentrating lime juice? You must know that it has been a difficulty always suggested with sledge parties, that to carry lime juice they must get a certain quantity of fuel for the purpose of melting it, or rather of melting the water to mix with it, and that that was the reason given by Sir George Nares and all connected with his expedition, and with previous expeditions, for not taking lime juice on sledge journeys. Now it has been brought before us in several forms that it might be possible to concentrate lime juice in such a way that it might be carried without the necessity of mixing it with water, or that if frozen it might be partaken of?—We have tried experiments at Netley, and have reduced lime juice to a small bulk, one-tenth and one twentieth of its bulk, and so on, and found that there was no change in its chemical constitution upon redissolving it again and mixing it with water. The amount of acidity remained the same, and the fragrance appeared to be not altered in any material degree. And in some of the experiments made at a previous time by the late Dr. Parkes, he found that even on evaporating the lime juice to dryness there was no loss of acidity.

5105. And what size could you reduce an ounce of lime juice to by that process?—An ounce of lime juice might be evaporated to dryness, and it would not weigh more than about 50 grains, I should say.

5106. Then in fact an ounce of lime juice might be carried in the shape of a small lozenge?—Yes.

5107. And each man might have had in his pocket his rations for 30 or 40 days?—Yes.

5108. And thus have really taken it without any inconvenience, and without any excess of weight worth considering for an instant on the sledge journeys?—Yes.

5109. And you believe that it would have had the same efficacy as administering the usual ration of lime juice that was given on board ship, namely, an ounce a day?—I think so. The only difficulty would be that from the extreme acidity of a concentrated material of that sort men would probably not care to take it; it would require the addition of sugar.

5110. We have had a sample put before us where four lozenges were equal to one ounce of lime juice and these were extremely nice. They had been prepared in London, and really were palatable and agreeable to the taste. But you think the more concentrated form would be too acid?—Too acid to be taken. It would be unpleasant.

5111. Then I should like distinctly to understand from you, first, that you consider that the use of lime juice would have acted as an anti scorbutic in the first instance?—Yes.

5112. That if continued it would have entirely warded off scurvy?—I will not say "have entirely warded off scurvy."

5113. In a great measure?—It would have gone a long way towards doing so.

5114. And that it might have been carried in a concentrated form which would have been perfectly applicable for the use of men on a sledge journey?—I think so. I am not prepared to say whether the actual lime juice itself, reduced in the way I have mentioned, would act so well as lozenges prepared with citric acid. I consider that citric acid is the active agent in the lime juice.

5115. I think we have been told in evidence that citric acid was not considered so good as the lime juice. That was distinctly said by one medical officer who gave evidence; but you consider that the citric acid is more effective?—I consider that citric acid is the active part of lime juice, and therefore that making lozenges of citric acid would answer the purpose, and if these lozenges were made with sugar and with the addition of a little flavouring of oil of lime, it would make a palatable lozenge which the men would eat.

5116. Is there anything else with respect to the present inquiry which you can suggest, and which might be beneficial for the inquiry upon which we are engaged?—I do not know that there is anything. I think the chief points I have already answered questions upon.

5117. (*The Chairman.*) We have it in evidence that the rum was found valuable when the men camped in the evening, and were very much distressed, and that not unfrequently they could not take their wet foot gear off till they had their rum.—I think that that is probable.

5118. And in that case it might be useful?—Yes, because then the men would have time to rest before they were called upon for subsequent exertion. The evidence of the Ashantee expedition, at least the evidence of some of the medical officers, tended in that way too. They considered that the ration of rum at night after the marching was over was a good thing for the men.

5119. Will you look at this Return, "An Abstract of carbonic acid estimations on board H.M.S. 'Alert,' winter, 1875-6." I wish to know whether you have any observations to make which may occur to you on that?—I should say, after looking at this, that the air was extremely impure on board the ship. The maximum is 482 per cent., as I see here, a very large amount of carbonic acid. That would show that the amount of fresh air supplied was not more than 140 to 150 cubic feet per head per hour. The lowest number is 221 per cent., which would correspond to about 340 to 350 cubic feet per hour; so that the best of these conditions shows not much more than one-tenth of the amount of air which we require to keep an air space properly sweet.

5120. Under the conditions under which that analysis was made, would you be disposed to place much dependence on it?—Well, the analysis is not a very difficult one if the proper apparatus is at hand, and I presume it was; and the quantities appear to be not very far different from what one would expect under the circumstances.

5121. What bearing has this remark upon the question, "Estimations of carbonic acid in arctic air gave results not differing widely from well-known observations at elevated positions in Europe"?—That is the estimation of the amount of carbonic acid in the external air. It is merely to show that the amount of carbonic acid in the ship itself would not be accounted for by any excess of carbonic acid in the external air.

5122. Can you acquaint the Committee with the cubical space per head allowed in troop ships?—At this moment I do not remember the amount. I should think about 200 or 240 cubic feet.

5123. (*Admiral Inglefield.*) Is that in the Indian troop ships?—Yes, in the Indian troop ships, but I am not certain at this moment.

5124. (*The Chairman.*) How would you be dis-

posed to account for the comparative immunity from scurvy enjoyed by previous arctic expeditions, the conditions in point of the character of the vessels being very much the same, and lime juice, so far as we can ascertain, having been very little used on their sledge journeys, which were very extensive?—Without full data it is difficult to give any opinion that would be worth much. The question is whether those other parties had anything else to make up for the absence of lime juice.

5125. (*Dr. Fraser.*) Of course, however impure the atmosphere in the ships may have been you do not think that is at all a specific cause of scurvy, do you?—By no means.

5126. In fact if there were no other cause of disease than an impure atmosphere scurvy is by no means a disease you would look for, is it?—No.

5127. The impure atmosphere, along with other causes which have been named, only operated by reducing the physical strength and standard of health in the men; that is all you mean?—Yes.

5128. Not that it had any specific influence in the production of scurvy?—Quite so.

5129. (*Admiral Inglefield.*) Have you formed any opinion as to the right age that men should be for this special service?—I think from 25 to 30 would probably be the best age.

5130. You probably have read an account of the voyage, if I may so term it, of nineteen individuals upon an ice floe from Littleton Island in Smith's Sound down to latitude 53°, where they were rescued, and that those people, all but four being Europeans, had no other food but pemmican and biscuit bread in the shape of preserved provisions, the rest being entirely seal's meat and bird flesh, and yet there was no symptom of scurvy amongst them during the whole of that lengthened drift. Could you attribute any reason for that immunity from scurvy?—The fresh meat would in all probability act to a certain extent as an antiscorbutic.

5131. And do you consider seal's meat especially so?—From what has been stated by arctic voyagers it seems to be so. But another point is that there was an absence of the predisposing cause of excessive fatigue most likely under those circumstances.

5132. Yes, the fatigue was only occasionally, and the seamen spent the greater part of their day, when not obliged to be out hunting, in sleeping in their snow-huts. It has been considered in some arctic expeditions that the want of exercise was a predisposing cause; and in Barentz's first voyage he insisted upon the men going out every day at Spitzbergen to walk about on the ice, and thereby he considered he deferred the attack of scurvy. You consider that seal's meat and the supply of fresh provisions made up for the want of vegetable diet?—Apparently to a certain extent.

5133. But do you look upon that as a very exceptional case?—I should be inclined to do so if we are in possession of all the facts of the case.

5134. I have just gone through it, and from the

time they left Littleton Island up to the time of their release, I find that they took nothing in the shape of prepared food but this pemmican and bread; they had neither tea nor vegetables of any description, excepting a little tobacco; nineteen individuals for 6½ months on an ice floe. I only mention it that you may have that particular case before your mind in giving the Committee an opinion as to the use of special diet?—We are also in possession of evidence showing that where men are fed on plenty of fresh meat and bread scurvy still occurs. My colleague, Dr. Aitken, mentioned to me the other day that one of the worst cases he has seen of scurvy in this country was in the case of a gentleman, a friend of his own, who from some idea of dieting himself had lived for some time on nothing but bread and meat. His appetite was good and he ate plenty, but he ate no vegetables at all, and he did not know what was the matter with him until Dr. Aitken examined him on one occasion and found symptoms of scurvy, and elicited from him his diet; and by immediately putting him upon a diet of vegetables, in addition to his other diet, and giving him lime juice, he very soon recovered, and in about six months he was quite restored; but he was reduced to such a condition that he could pull his teeth out with his fingers.

5135. Bread is in no way an antiscorbutic is it?—To a certain extent fresh or soft bread probably is, because in all bread there is a certain amount of vegetable acid.

5136. And there are no ingredients in pemmican, I presume, that are antiscorbutic, excepting in a mixture of fresh meat?—None of the vegetable acids, of course, except it may be possibly lactic acid in the flesh.

5137. What these men, to whom I just now referred, used was what is known as American pemmican, which is different from ours as it contains a certain quantity of raisins and currants?—That would certainly act as an antiscorbutic.

5138. We have had it in evidence that there are two species of pemmican, one mixed up of meat entirely deprived of tendon and other indigestible substances, with fatty material to preserve it, and, you may say, highly compressed; the other not, to my mind, nearly so palatable, is mixed with raisins and currants more like a pudding, and that is the particular kind that the Americans supplied to their expedition. So that in all probability the pemmican which was issued to these people on the floe was that American pemmican which contained as a constituent part raisins and currants. That you consider would have acted as an antiscorbutic?—It was probably the active cause of their not having scurvy. In the same way I have been told of cases of long journeys being made across North America from end to end, where the people had nothing but pemmican to eat; but if it was that kind of pemmican it is not surprising.

5139. I think the Canadians also adopt the same process?—Yes.

The witness withdrew.

Adjourned to to-morrow at 11 o'clock.

F. S. B. F. de
Chaumont,
Esq., M.D.,
Surg.-Major.
24 Jan., 1877.

THURSDAY, 25TH JANUARY, 1877.

PRESENT :

ADMIRAL SIR JAMES HOPE, G.C.B., in the Chair.

ADMIRAL SIR R. COLLINSON, K.C.B.

VICE-ADMIRAL E. A. INGLESFIELD, C.B., F.R.S.

JAMES J. L. DONNET, Esq., M.D., Inspector-General of Hospitals and Fleets, R.N.

THOMAS R. FRASER, Esq., M.D., F.R.S.E.

H. J. VANSITTART NEALE, Esq., Secretary.

FREDERICK WILLIAM PAVY, Esq., M.D., F.R.S., *examined*.F. W. Pavy,
Esq., M.D.,
F.R.S.

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5139a. (*The Chairman*.) You are a Fellow of the Royal Society, a Fellow of the Royal College of Physicians, and Physician to and Lecturer on Physiology at Guy's Hospital?—I am.

5140. You are also author of a work entitled a Treatise on Food and Dietetics?—I am.

5141. (*Dr. Fraser*.) I think you have had before you a number of printed papers, describing to some extent the proceedings of the recent arctic expedition?—Yes, I have, and have gone carefully through them.

5142. You have also had the dietaries of that expedition placed before you, have you not?—I have.

5143. And you have carefully perused them?—Yes.

5144. You have devoted very considerable attention to the subject of food, have you not?—I have, in all its aspects.

5145. And to the construction of dietaries?—Yes, also to that.

5146. And to the value of the several food principles in dietaries?—Yes.

5147. From your study of the papers which I in the first instance referred to, are there any matters connected with the recent expedition which strike you as being worthy of special investigation?—It has occurred to me, from a perusal of the papers, that great advantage would be derived from picking out the particulars bearing upon the subject of scurvy, so that we may have concisely before us the facts to be dealt with. The mind will thereby more rapidly grasp them and enable us to draw conclusions therefrom. In an investigation of this kind, it appears strongly to me, that the more clearly and more precisely we have the facts before us, the more likely are we to arrive at a correct judgment; and I thought it might assist the Committee if, from a medical point of view, I laid before them the salient points. The main points I consider are these: that an expedition, composed of men who may be looked upon as having been, amongst other qualities, picked for their strong constitutional power, their good health, and their power of endurance, started from England in the "Alert" and the "Discovery" at the end of May, 1875; and arrived towards the end of the summer at their winter quarters in the arctic regions. During the autumn, before the sun left them, many of the men were exposed to great exertion in making sledging journeys. The report of Sir George Nares at this time runs: "During these autumn sledging journeys, the heavy labour, hardships and discomforts inseparable from arctic travelling, caused by the wet soft snow, weak ice and water spaces, which obliged the sledges to be dragged over the hills, combined with constant strong winds and misty weather, were if anything much greater than those usually experienced." This shows that at that time many of the members of the expedition were exposed to great labour and hardships, and nothing is said of any illness amongst them. They then passed through a long winter with a continued absence of sunlight, which, in the position of the ship "Alert" is stated to have extended from October the 12th to March the 1st, or to have lasted 142 days; and, in that of the "Discovery," from October the 16th to February the 29th, or 137

days. The fixed dietary during this period comprised, besides other articles, preserved meat and a certain amount of salt meat, preserved and dried vegetables, and lime juice. I need not enter further into detail with regard to that dietary, because it is upon the table before us; but in addition, as I shall presently refer to, some fresh meat was obtained under the form of game. Throughout this time there is only one case of scurvy reported; none at all during the toil of the autumn sledging expeditions. The occurrence of this case of scurvy during the winter is commented upon by Captain Stephenson in the following way: "On the 3rd of January, Dr. Ninnis reported James Shepherd, cooper, on the list, with scurvy. A medical inspection, however, dispelled our fears; for, in using the surgeon's own remark on the result, 'there was not a foul tongue in the ship.' With the exception of Shepherd, who is constitutionally predisposed to scurvy, there could not be a healthier body of men." This, from the reports before me, constituted the only case of scurvy that occurred amongst the crews during the long winter imprisonment of both the "Alert" and the "Discovery." At the end of this winter confinement, Sir George Nares' report, regarding the state of his crew, runs: "The health of the officers and crew, with only one exception, was most excellent"; and Captain Stephenson says: "The conduct of the ship's crew has been all that could be desired, and their health and spirits (with the exception of what has been said about Shepherd, the man attacked with scurvy) has been excellent; but at present all look pale and bleached." It is a noteworthy point, bearing, I consider, upon the future events, that during the period I have been drawing attention to, a difference existed in the food supply on board the "Discovery" and the "Alert." The "Alert's" crew had little more than the official dietary, on account of the vessel being situated in unfavourable quarters for procuring game. Upon this point Sir George Nares says: "The vicinity of our winter quarters proved to be unfavoured with game. On our first arrival a few ducks were seen, and five shot, and during the winter and spring three hares were shot in the neighbourhood of the ship. This completes our list up to the end of May." The "Discovery," on the other hand, was placed in a more fortunate position for securing fresh food; and in Captain Stephenson's report we have a record of the amount of game procured from month to month, in conjunction with details regarding the amount of fresh meat served out. I do not know that it will be necessary to give full particulars regarding the game, but it amounts to something considerable. I may mention to the Committee that there were 32 musk-oxen, 6 seals, 30 hares, 8 ptarmigan, and 5 eider-ducks, obtained between September and the end of March. The point of importance is, that a considerable amount of fresh animal food was obtained by the crew of the "Discovery" and scarcely any by that of the "Alert." We have now arrived at the time when the spring sledging expeditions are to commence. Sir George Nares says, on the 3rd of April: "The seven sledges and crews, numbering 53 officers and men, started on their journeys with as bright prospects before them as any former arctic travellers; every one apparently in the best possible health." The men were now

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separated. There are the members of the crews remaining in connection with the vessels, and there are the members of the different long sledging parties; and I think it will be best to speak first of the men remaining in connection with the vessels. The following seems to be the first report of the outbreak of scurvy, and it is from the "Alert" that it comes. On the 3rd of May, Sir George Nares says: "Dr. Colan reported that five men had scorbutic symptoms; however, as each case had some predisposing cause, I was not alarmed, until on the 8th the three ice-quartermasters and two able seamen returning from sledge service" (I imagine this to be a short sledge service) "were attacked, and by the 8th of June, fourteen of the crew of the "Alert" and three men belonging to the "Discovery," who happened to be on board, forming the majority of the number of men then present, had been, or were, under the doctor's care for the same wasting disorder." The three men here referred to of the "Discovery," I apprehend, wintered with the "Alert." There were certain men belonging to the "Discovery," who during the autumn were transferred to the "Alert," in company with Lieutenant Rawson and wintered there, and it would appear that these three men spoken of as belonging to the "Discovery" wintered with the "Alert"; so that they would be in the same position as the crew belonging to the "Alert." At this time Captain Stephenson reported that four of his crew were attacked with scurvy, and as it is elsewhere stated that five of the "Discovery's" crew suffered from scurvy, I take it that the five are made up by the four here referred to by Captain Stephenson, and the one case that occurred during the winter. This seems to be the only occurrence of scurvy amongst the crew of the "Discovery" not engaged in the long sledging expeditions.

5148. You say that you imagine that five men of the crew of the "Discovery" were attacked with scurvy, without having previously been engaged in long sledging?—They all appear to have been engaged more or less in short sledging expeditions, but not engaged in the long sledging expeditions. Confining our attention to the men who were not engaged in the long sledging expeditions a great difference is perceptible in the amount of scurvy occurring amongst those who wintered on board the "Alert" as compared with those who wintered with the "Discovery." To summarise, the cases stand thus: for the "Discovery" we have five cases, but one of them, that of James Shepherd, occurring on the 3rd of January, occupied an exceptional position and leaves us with four cases for the spring outbreak. As regards the "Alert," there are the fourteen cases strictly belonging to the vessel and the three others of men who originally belonged to the "Discovery," but who had wintered on board the "Alert." That is the summary for one portion of the party. Now for the long sledging expeditions: Commander Markham was engaged on the northern sledging expedition, and of the 17 composing his party only the two officers escaped. Of Lieutenant Aldrich's "Grant Land" exploration party, it is stated that all, except the officer and one man, were affected. News up to the 25th of April represented them to be all well, but when met by Lieutenant May's relief party on the 20th June, six were ill, two struggling along by the side of the sledge and four obliged to be carried. Lieutenant Giffard, who had been engaged in conveying provisions for Lieutenant Aldrich's party, returned to the "Alert," May 24th, with two cases of scurvy. These comprise the sledging expeditions which started from the "Alert," April 3rd. I now pass to the sledging expeditions to the coast of Greenland. Lieutenant Beaumont's party started from the "Discovery" April 5th, reached the "Alert" April 16th, and left that vessel for their expedition April 20th. They were eight in number. The first person attacked in this party was Hand, and scurvy showed itself in him on May 6th. It appears that Hand, although belonging to the "Discovery," had wintered on board the "Alert." May the 16th,

Jenkins, Craig, and Paul showed symptoms of scurvy. May the 18th, Jones was added to the list of "stiff-legged ones." May the 22nd, five of the party of seven (Hand had been sent back with Lieutenant Rawson's party, May 11th) were now affected. June the 22nd, Lieutenant Beaumont himself showed symptoms of scurvy; and June the 24th, Gray, the only remaining member of the party, is reported as affected with the disease. Thus all the party became attacked, and it is noticeable that in this case the officer suffered as well as his men. Lieutenant Rawson's party consisted of himself and three men. They first accompanied Lieutenant Beaumont and then returned with the scurvy-stricken man, Hand. It is stated, May the 11th, that Bryant's legs were giving him trouble. May the 16th, Lieutenant Rawson speaks of his own legs, and says that he is obliged to bandage them; but May the 18th, he says that they are cured, and there is no subsequent remark relating to scurvy in his case. May the 30th, Rayner's legs were very stiff, but this is all that was said about him. When seen by Dr. Coppinger, June the 7th, it is reported that O'Regan, the remaining man of the party, was suffering from scurvy. As regards Lieutenant Rawson's party, therefore, two of the men showed unmistakable symptoms of scurvy; and the report as to the third is, that his legs were stiff, whilst there is just the circumstance spoken of, that bandaging was required by Lieutenant Rawson. It may be incidentally mentioned, that this party, although belonging to the "Discovery," wintered on board the "Alert." What I consider to be the most important points for consideration connected with the whole history, are, that the crew of the "Alert" suffered more than the crew of the "Discovery"; that in the long sledging expeditions nearly all the persons engaged suffered more or less; that the officers experienced a greater freedom from the disease than the men; and it is of importance to notice, in connection with the great prevalence of scurvy amongst the sledging parties, that there was a material alteration in their dietary from that employed on board the vessels, the sledging dietary consisting of dried food, without lime or lemon juice, and only including, as representing anything of an anti-scorbutic nature, two ounces of preserved potato. There are also the points, that no scurvy occurred during the preliminary autumn sledging expeditions, and that there is only one case of scurvy mentioned in the reports as having occurred amongst the ships' crews throughout the winter. These, I think, are the main points that we have to deal with. I dare say questions will be put to me concerning the food, &c., supplied when the sick persons obtained assistance, and recovery from their disease took place.

5149. In the very interesting statement which you have given us, you are led to the conclusion, I think, that it is very material to consider that the dietary of the sledge parties was different from that on board ship?—I consider that there is great importance to be attached to that.

5150. Can you give the Committee any explanation of your reason for attaching so much importance to this difference?—Observation has shown us that scurvy depends upon the absence of the proper quantity of succulent fresh food.

5151. May I ask, whether you mean animal or vegetable food, or both?—Fresh vegetable food has more influence in protecting from scurvy than fresh animal food. I would observe, further, that everything tends to show that it is not this or that particular article of food which occasions scurvy, but the absence of food which may be considered as belonging to a natural diet.

5152. What has experience proved to have been, in previous outbreaks, the most common constituent in natural food, which has been found absent when scurvy has occurred?—Fresh vegetable food, or its representative, some kind of vegetable juice.

5153. Are you aware whether there have been authentic accounts of outbreaks of scurvy where

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there was an abundance of fresh animal food?—Yes, I am under the impression that I have read of such. I may observe that I thought Dr. Kane gave particulars from which I might show that with animal food scurvy occurred; but I see there is nothing specifically showing that. We have merely the general information that in the arctic regions, persons living upon fresh meat do suffer from scurvy. The Esquimaux, who are surrounded by an abundance of fresh animal food, suffer from scurvy. Dr. Kane, from his expedition, was led to attach great importance to the protective value of fresh animal food. He makes, for instance, these remarks at the end of the second winter of his campaign: "Our sick are sinking from want of fresh food: it is our only specific, but in our case it is the true one. In large quantities it dissipates the disease, in ordinary rations it prevents its occurrence, in small doses it checks whilst sustaining the patient." Later on he says: "The most severe cases of scurvy are beginning to feel the influence of the raw walrus flesh, and are improving." In another part he says: "Scurvy is badly again amongst the party. Had we plenty of frozen walrus, I would laugh at the scurvy." And in harmony with these observations, it is to be noticed that the members of the sledging parties of Sir George Nares' expedition rapidly improved directly they were supplied with fresh meat and lemon or lime juice. There is a remark made by Lieutenant Beaumont, when he arrived at Polaris Bay, to this effect: "It will now be necessary to allude briefly to our stay at the depôt in Polaris Bay. The sick were under the care of Dr. Coppinger, and steadily improved from the first. My stiffness became worse after we arrived, but it was never very much. Seal meat and game were procured in sufficient quantities to supply the sick entirely, and the benefit derived was great." I think we cannot refer the improvement in the men to any medical treatment that was resorted to, because we know of no medicine, strictly speaking, which has a direct influence over the complaint; and we can only refer the improvement to the fresh meat which was obtained, and I think also, to an important degree, to the lime juice, which had been found at the depôt and was administered.

5154. In this instance, when you talk of no medicine, I presume you do not include lime juice?—I look upon lime juice as the representative of a dietetic article. I look upon it as the most convenient form of giving a substitute for fresh vegetables.

5155. You will recollect, perhaps, that I have wished you, if possible, to favour the Committee with any instances which you may be prepared to give, in which, during an abundant supply of fresh meat, scurvy had occurred?—I cannot give any specific instance; I can merely speak in general terms that scurvy occurs in the arctic regions amongst the Esquimaux who are surrounded with fresh animal food; and it is generally admitted by those persons, or by persons who have made observations upon the point, that meat in a raw state is more efficacious than cooked meat.

5156. Is that your opinion?—That is my opinion.

5157. The cooking materially alters the chemical composition of food, does it not?—It does.

5158. And more especially the organic salts, which are so prone to decomposition at high temperatures, may be naturally suspected to be changed by cooking?—Certainly.

5159. And it is, in all probability, those organic salts which are the efficient agent in antiscorbutics, so called?—I would not like to commit myself to chemistry. I think it is far better to keep simply to the results of observation, namely, that vegetable juices, or vegetable products, do confer an immunity which is not enjoyed without them. If the Committee would allow me, I would just refer to another instance in the report of Dr. Kane's expedition, bearing upon the point that I just now alluded to with reference to the position of raw meat. In the middle of the winter, on December the 12th, Dr. Kane says that Hayes' party, that is, one of the two sledging parties into which the company had been divided, returned to

the ship from a sledging excursion of 350 miles, and that for more than two months they had lived on frozen seal and walrus meat. He speaks of them as arriving in a prostrate state; but there is nothing said of scurvy being amongst them. So that we have here a party, which had been exposed to the exertion and hardships of sledging in mid-winter, living upon frozen seal and walrus meat, and no mention made of scurvy occurring amongst them; and I presume, also, from their position that they must have been more or less entirely deprived of any kind of vegetable food.

5160. I think, also, you said that prostration was noted?—Yes. I take this to mean exhaustion from great toil and exposure. It says: "in a prostrate state," but nothing is said of scurvy being amongst them. He speaks of scurvy existing at the time amongst his own party on board ship, but he says nothing of scurvy existing amongst this returning sledge party; indeed he comments upon how, upon their arrival, they relished the salt pork, "which our scurvy forbade us to touch."

5161. In the book to which the Chairman has referred, and of which you are the author, you quote, do you not, at page 476, an interesting passage, with reference to the Icelanders, from "Mackenzie's Travels"?—I do.

5162. The general purport of that passage is, I think, that when the Icelanders have milk and other animal food, and have not vegetable food, they suffer from scurvy?—That is the purport of the passage.

5163. And that for the cure of that scurvy a vegetable diet is employed?—Yes.

5164. How do you account for the difference in the proportion of cases amongst the officers and the men generally in this expedition?—I can only surmise that it depends upon the difference in the food which had been taken during the winter.

5165. We have it in evidence that the officers were supplied with a greater variety of food, having carried some extra comforts with them; would that, do you think, account for the difference?—I am of opinion it would; and, without knowing what you have just stated, I had drawn the inference in my own mind, that the officers would be in a position to provide themselves with articles of a vegetable nature, preserved fruits, preserved vegetables, tin vegetables, which the men would not obtain. The officers might take the same food as the men, but if they took in addition these preserved fruits and vegetables, they would acquire, I consider, a power of resistance against the disease, which the men would not possess.

5166. By having a few additional articles of food, they might also, might they not, have varied their diet, and so have accomplished a more perfect nourishment of their bodies?—That is quite true. I consider that by a variety in the diet there is an inducement and an inclination for more food to be taken, and that the body is thereby likely to be maintained in a better nourished condition.

5167. It is not merely a question as to more food being swallowed, but the more perfect accomplishment of the digestive act, and the assimilation of the food?—Yes; of digestion and assimilation. If you will allow me, I may state that this is not a solitary instance in which the officers have suffered less than the men. It is reported that, during the war between the Austrians and the Turks, in 1720, when the imperial army wintered in Hungary, many thousands of the common soldiers but not one officer were cut off by scurvy. In Dr. Kane's expedition, the officers suffered equally with the men, but it appears that the officers and men lived together upon precisely the same food.

5168. The officers on board the "Discovery" always had butter, milk, cheese, jams, sauce, soup, rice, ham, tongues, and a few vegetables, and a greater change, generally, besides an allowance of wine daily. That statement would show, would it not, that there was a sufficient possible variety in the dietary to effect a more complete nourishment of the body, as well as

to administer some specially antiscorbutic articles of food?—I think so.

5169. The jams, of course, may have been antiscorbutics, besides some other things?—Yes, I should look upon them in that way.

5170. With reference to a matter which is very important, and to which you have directed special attention, namely, the difference in the quantity of game procured by the two ships; is it your opinion that that difference operates very much in the same manner as these last differences which we have been talking about; that is to say, that it allows a greater variety of food to be taken, and, probably, a better state of nourishment to be obtained?—Certainly; besides possessing antiscorbutic properties. Fresh game I would put next to vegetable food.

5171. Still, fresh game, cooked, in your opinion, I think you have told us, is not so valuable an antiscorbutic as when it is raw?—It is not.

5172. What is your general opinion respecting the ship's dietary?—I thought it was a good dietary; but it appeared to me that under the special circumstances, the crews having to pass a long winter in the arctic regions, it would have been advisable to have increased the allowance of lemon juice beyond that ordinarily given in the navy. One ounce per diem per man is, I understand, the ordinary ration in the navy, and, under these special circumstances I think that it would have been advisable that a larger amount of lemon juice should have been given.

5173. You have not observed, perhaps, that during the month of March in one of the ships the allowance of lemon juice was doubled previously to the general outbreak of scurvy?—I noticed that on the return home the allowance was for a time doubled and even trebled.

5174. Did you notice that in March previously to the chief sledging in April, the allowance in the "Alert" was doubled?—I did not notice that.

5175. I think, in reference to the possible absence of power of this dietary to prevent scurvy, you are going upon the assumption that five or six cases of scurvy occurred during the winter on board the "Alert"; is that so?—I infer those cases did not occur until the spring. May the 3rd was the date of the first report of the outbreak.

5176. In what respect, then, do you think that the ship's dietary was unsatisfactory in so far as the health of the men was concerned?—There is nothing said to show, although we are speaking of the ship's crew, that the men affected had not been engaged on short sledging expeditions.

5177. Therefore, they might have been engaged?—Yes. In other parts of the report it says that most of the crew were engaged on short sledging expeditions.

5178. In four of those cases which are stated to have occurred on board ship, they did certainly engage in sledging expeditions, almost immediately previously to their illness, and they were therefore upon a different dietary from this on board-ship dietary?—I apprehend that would be the fact.

5179. Then it has been shown in evidence, that in two of the cases that occurred on board ship, a somewhat protracted previous illness had also existed, during which, of course, the nourishment of the men could not have been at all satisfactory?—Precisely so.

5180. Knowing these facts, would you regard the ship's ration as a satisfactory one, or not?—I may say, as I have already stated, that I do regard the dietary as in a general way satisfactory; but, looking at the experience which has been gained in this expedition, I think it would have been better if a larger allowance of lemon juice or lime juice had been supplied.

5181. You have not any fear, have you, that an increase in the allowance of lime juice, for instance an increase to two ounces, necessitating probably two administrations during the twenty-four hours, given to the men in the abnormal conditions in which these men were placed during the winter, would have any

prejudicial effect whatever on the digestion, for instance?—Certainly not. I believe it is mentioned, that on their voyage home the quantity was actually increased to three ounces per diem.

5182. I am not speaking, of course, of the end of the summer when those abnormal conditions were not present?—Just so; I quite understand you, and am of opinion that the same would apply.

5183. With reference to the sledge-party dietary, with the exception which you have stated, does it seem to you to be a satisfactory one for hard work?—Yes.

5184. May I ask if you have calculated the proportions of food constituents contained in it, that is to say, the albuminates, the carbo-hydrates, and that sort of thing?—I have not entered into that calculation; but, looking at the quantities in a general way, it appeared to me to be quite sufficient for hard work. I must, however, say that I consider we ought to look upon the dietary from two points of view, that which will sustain the body for work and exposure to cold, and that which will preserve the body in a state of health. Food is required for work and for keeping up the bodily temperature; and also certain materials, not specially contributing to these purposes, will be required for maintaining the body in a state of health. This dietary appeared to me to be a good working dietary, as far as capacity for producing power is concerned, but not a suitable dietary for maintaining health.

5185. You mean, of course, that a distinction must be drawn between the potential energy of the food and that available for work?—A distinction should be drawn between the food from which we get power, and that which is required to maintain the body, or keep the body, in a healthy state.

5186. Knowing as you do the conditions in which these men were placed, do you think that it would have been important that the quantity of the albuminates, or carbo-hydrates, or fat, should have been somewhat in excess of average dietaries?—They are in excess, for I see that the dietary includes 1 lb. of pemmican—pemmican is a very concentrated food, very rich in albuminates and in fat; a $\frac{1}{4}$ lb. of bacon; 14 oz. of biscuit; and 2 oz. of preserved potatoes, besides 2 oz. of sugar and 1 oz. of chocolate. I consider that the dietary includes all that is really requisite, or even, I will go so far as to say, all that I think likely to have been susceptible of being made use of by the system for application to work.

5187. In fact it is a dietary which has been most skilfully prepared for the work which was done, had it been so designed?—Merely as a working dietary—yes: not referring to that which is required to keep the body in a healthy state.

5188. But there is what you have yourself referred to, absent from it?—There is.

5189. If you had not known the history of this outbreak of scurvy in connection with the sledge parties, and if you had been shown this dietary, and had observed that the vegetable food was represented by only 2 oz. of preserved potatoes, would you have anticipated the occurrence of scurvy under the use of such a dietary?—Unquestionably so.

5190. You think, therefore, that 2 oz. was unquestionably too small a quantity?—Certainly; I should have felt that had we to have dealt with persons starting in a healthy condition upon this dietary, and if it were intended that they should subsist upon it long, scurvy might be expected to occur amongst them; and in this case, we have the men starting away after the debilitating influence of their long confinement during the winter.

5191. You know, I presume, the general conditions, in fact I think you have already stated them, to which those men were subjected, that is to say, prolonged darkness, the cold, the dampness, the great fatigue endured, and possibly for some time, the subjection to a somewhat vitiated atmosphere. Can any of these causes, or can a combination of these causes produce scurvy, independently of any fault in

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diet?—I will not go so far as to say it is utterly impossible that they can, but, so far as our knowledge goes, there is not evidence that they directly do; and if you will allow me I will quote from Sir Robert Christison upon this point—He says: "But all observers and authors of credit insist on the necessity of some dietetic error as the cause of scurvy. Confinement, inactivity, damp, foul air, these are all acknowledged to be co-operating agents, which promote the spread of scurvy, but no man ever saw any or all of these causes together engender the disease as an epidemic, unaided by some tangible error in diet. They are not even essential for developing the action of faulty diet. They promote it, but certainly dietetic errors will occasion scurvy, although the subjects of it have been living at large, following active employments, breathing the open country air, and not more exposed to damp than most of the working classes of the community." That passage, which is from the "Edinburgh Monthly Journal," of 1846-47, bears directly upon the question asked.

5192. There were also cases given in that journal, so far as I can now remember, in which on an allowance of meat and bread, and in the absence of vegetable food, cases of scurvy have occurred amongst railway workers; can you remember that?—I think it was especially a diet of farinaceous foods, bread and oatmeal, and but a small allowance of meat, and an absence of milk. Sir Robert Christison shows that where milk entered largely into the dietary, there was not the same occurrence of scurvy.

5193. You have not, perhaps, compared this dietary with that of men employed in usual or hard labour?—I have not made a special comparison.

5194. Do you agree with the opinion which you have quoted from Sir Robert Christison, that milk is a very important article in dietaries?—Yes, if certain other kinds of food are absent.

5195. It is, however, a convenient food, is it not, in so far as it contains all the essentials of proper food?—It contains all the elements that are required by the body.

5196. You have devoted some attention to the action of alcohol, have you not?—I have.

5197. What is your general opinion respecting its value as an addition to the dietary of men engaged in hard work, and especially in hard work in the arctic regions?—We cannot speak very precisely about its alimentary value—whether or not it is applied to force production. From the evidence which has been adduced, I am myself of opinion that alcohol is of alimentary value, or susceptible of application to certain requirements of the system, and not simply to be regarded as a stimulant and narcotic.

5198. You think it a carbo-hydrate, do you?—I think it acts in the same manner.

5199. And, therefore, of value in sustaining the animal temperature, if nothing more?—Contributing to that; and then it possesses the other properties of acting as a stimulant and a narcotic, and these properties would be quite independent of its alimentary value.

5200. What is your opinion with reference to its physiological action upon the blood vessels?—The first effect of alcohol is to stimulate and increase the rapidity of the action of the heart, and to accelerate the flow of the blood through the vessels, particularly of the surface of the body.

5201. It accelerates the flow of the blood through the vessels, but does it at the same time increase the calibre of the vessels, or what is your opinion upon that subject?—We may say that it does increase the calibre of the vessels, from our observing that the face becomes flushed. The vessels of the skin, therefore, must contain more blood.

5202. If the vessels of the surface are dilated, and more blood is passing through them, what would be the influence of exposure to extreme cold on the general temperature of the blood under those circumstances?—There would be a double effect. The increased activity of the circulation will lead to an increased

development of heat, but this increased development of heat will be counteracted by a more rapid escape of heat favoured by the warm blood carried to the surface. When a large quantity of blood is flowing through the vessels of the surface, the escape of heat will be greater than when only a small quantity is flowing through them.

5203. Then, the escape of heat will vary from that source of escape according to the temperature, will it not?—It would; and what occurs is entirely in accordance with the ordinary physiological change occurring under exposure to heat and cold. The effect of exposure to cold is to contract the blood vessels of the surface, and to drive the blood towards the centre of the body; and there being a less amount of blood circulating through the surface, there is a less conducive condition to escape of heat in harmony with what is wanted for the maintenance of the body temperature. Where, on the other hand, an active escape of heat is required, as under the condition of persons living in a warm climate, an increased vascularity of the skin is induced: exposure to heat increases the vascularity of the skin, and from the larger amount of blood flowing through the skin, the perspiratory glands secrete an extra amount of fluid under the form of perspiration, which, in evaporating tends to keep down the animal temperature.

5204. You are therefore in favour of retaining the ration of alcohol in the arctic regions, are you not?—I consider it is advisable to be retained, and I would express this opinion, not with special reference to its action as a food, but from its general effect upon the system. I consider that the employment of alcohol is unadvisable during the performance of hard work. I consider that, if taken during the time of the performance of work, it diminishes the capacity for its easy accomplishment. Persons at the time of work will not do the amount of labour upon alcohol that they could do without it. Alcohol, besides acting as a temporary stimulant to the circulation, affects the nervous system, it acts as a narcotic. It diminishes the tension, one may say, of the nervous system; it diminishes the sensitiveness; it blunts to a certain extent the sensibility; and, when taken after the performance of work, I consider certainly it is calculated to prove of considerable advantage by relieving the state of the nervous system induced by exhaustion. A person may be in a sensitive, watchful state, as the result of exhaustion, and not be able to obtain sleep; but should alcohol be taken under these circumstances, it will diminish the sensitive state of the system, and dispose to sleep, thereby enabling the person to recruit his power which otherwise he might not have been enabled to do.

5205. It has an effect also in small doses, on the mind?—On the nervous system altogether.

5206. I mean especially on the intellect or the emotions?—It makes a person feel more inwardly comfortable or contented, and more disposed to take rest.

5207. And from what you have said, you think it should be retained in dietaries of this description, and, if possible, administered at the end of the day's work; that is your general opinion, I gather?—Yes; I consider that it is calculated to diminish the liability to the ill effects of over action. I might summarise its utility in that way, it is calculated to diminish the liability to the occurrence of ill effects from over action and exhaustion.

5208. Can you express any opinion as to the quantity which you think would be a proper or convenient one to give for the purposes you have just stated, either in the form of any ordinary spirit or of absolute alcohol?—One ounce of alcohol is looked upon as the quantity which it is desirable to administer to produce the effects of the agent.

5209. It has been stated in this room, that an objection to the use of alcohol is, that it reduces the temperature of the body. Now, that observation is very much due, I think, to the researches of the late Dr. Parkes and some of his collaborateurs, is it not?—Yes.

5210. But the diminution of temperature under the most careful and refined observation was extremely trifling, was it not?—I think, if I remember rightly, that Dr. Parkes noticed a slight increase in his last observations; this is mentioned, I think, in my book.

5211. Then any diminution he noticed was excessively unimportant?—Yes.

5212. Can you give us briefly your views respecting the advantage or otherwise of tea during work in arctic regions?—I consider that tea occupies an antagonistic position to alcohol; that it is exactly the opposite in its physiological action; I consider that it sharpens the faculties, and renders a person more fit for both bodily and mental work.

5213. Then in reference to the use of tobacco, whether by smoking or by chewing, have you any opinion to offer?—I have not entered particularly into the question of tobacco, not looking upon it as a dietetic article, but I do not think that smoking in moderation would do any harm; in fact, by its soothing influence, it might sometimes be of service.

5214. In the case of men accustomed to the use of tobacco, you think there are reasons for permitting its continuance in the conditions of the arctic expedition, rather than for encouraging its discontinuance?—Unquestionably, I would second its continuance.

5215. Can you give us any opinion in reference to the differences in the antiscorbutic power of dry and of fresh succulent vegetables?—The result of observation is to show that dried vegetables do not possess the power of fresh vegetables. They are to some extent antiscorbutic, but they do not possess the same power as vegetables in a fresh state.

5216. (*Dr. Donnet.*) I believe you attributed the outbreak of scurvy in the late arctic expedition to the material difference between the dietary of ships and the sledges, to the dried food without lime or lemon juice, and to the small amount of vegetable product represented by two ounces of preserved potatoes?—Yes.

5216a. Have you had any personal experience of vegetarians?—I have not.

5217. In allusion to the quotation from Sir Robert Christison, with regard to scurvy arising from a dietetic error, have you ever in your experience met with a case of scurvy in a person adequately supplied with fresh succulent vegetables of good quality?—I think in a matter of this kind we must not simply draw from our own experience. The experience of a person at the present time is happily very limited in scurvy; we chiefly draw from the experience which has been gained hitherto, but I have not seen such a case.

5218. May I ask you whether it is your opinion that scurvy will appear sooner under a salt meat diet than under a fresh meat one?—Unmistakably, it is my opinion that it will.

5219. Evidence has shown that the process of salting deprives flesh of its most important constituents, so that the remainder is deficient in nutritive qualities; is that your opinion?—It is deficient, especially in the juices, and it is the fresh juice which is especially antiscorbutic.

5220. Several of the witnesses complained of the insipidity of the preserved meats; do you suppose that this insipidity was due to their having lost any of their nutritive properties?—I do not think that meat in being preserved loses its nutritive properties; the elements are all there, but I think from the state that they are in, the preserved meat is not so conducive to the maintenance of health. The meat contains its original elements, the nutritive elements are there, or what is needed for carrying on the external operations of life, but I do not think that the meat is in so favourable a condition for maintaining the body in a healthy state. We must look to the maintenance of the body in a healthy state, as well as to the supply of material for meeting the loss from wear and tear.

5221. I would like to know whether you consider meats are rendered injurious by being preserved in tins?—Certainly not.

5222. Can you give any reason for the insipidity of these meats?—The heat to which they have been

subjected and the sameness in the food from day to day. We may relish a food to begin with, but if we are confined to it day after day, in the course of time we may find it insipid.

5223. (*Admiral Inglefield.*) I should like to ask a question with reference to the preservation of lime juice. Do you consider that lime juice is capable of being concentrated, and yet retains its beneficial effects?—Not concentrated by heat.

5224. Evaporating to dryness, you consider, would destroy its chemical properties?—I do; and its proper value as an antiscorbutic.

5225. Is that the result of observation and experiment?—It is not.

5226. Because we have had it in evidence, given to the Committee by a medical gentleman, that it might be concentrated, and that the amount which is usually issued as a ration, namely, one ounce, and which, in volume, is equal to the size of a bantam's egg, might be reduced to four lozenges, of which we have had specimens before us, agreeable to the taste, and containing all the antiscorbutic qualities of an ounce of lime juice?—Unless the observation has been directly made, that lime juice prepared in that way will protect from scurvy, I think it would be very unsafe to rely upon it. Knowing that albumen is coagulated and the constitution of vegetable juices altered by exposure to heat, I think we can only infer that the boiling of lime juice would more or less destroy its virtue. But it might be evaporated *in vacuo*, and under those circumstances I do not think that it would lose any of its value.

5227. I will show you the specimens to which I have been alluding, and which have been prepared with a special view to being fit to be carried on sledge journeys for the use of the men, without the great drawback which exists at this moment of carrying fuel sufficient for melting the frozen lime juice and the quantity of water necessary to mix with it?—If a sufficient amount of heat has been employed to coagulate the albuminous principles, the constitution of the juice would be altered; but if a sufficient amount of heat has not been employed in its preparation to produce that result, we may look upon it, I should consider, as in the same condition as ordinary lime juice. (*The lozenges were handed to the witness.*) They look very much like effervescing lozenges.

5228. They are made by Cooper, with the sole object of preparing lime juice so that it might be used on arctic voyages?—I feel confident that it would not be safe to rely on a preparation of lime juice, if a sufficient amount of heat has been employed to coagulate the albuminous principle in it.

5229. Though you may have no faith in that particular lozenge, still do you think it possible that a lozenge could be constructed and made useful for the service which I allude to?—Yes, if evaporation were effected without heat.

5230. *In vacuo* it might be done?—Yes.

5231. You consider it is possible to prepare lime juice with all the qualities necessary as an antiscorbutic under certain conditions, so as to be useful and portable by the men employed on the journeys?—I should think so.

5232. (*The Chairman.*) You have stated that the provisions supplied for the sledge parties were amply sufficient as regarded the performance of work, but deficient in those for the maintenance of health?—That is so.

5233. Be good enough to state in what respect they were deficient for the maintenance of health?—In vegetable products; deficient in the ordinary vegetable products, or the usual representative employed—lime juice or lemon juice.

5234. Assuming that the daily allowance of lime juice could have been administered to the sledge parties, are you of opinion that the outbreak of scurvy would have been delayed?—I am of that opinion.

5235. Are you further of opinion that it might or would have been averted altogether?—I think that is

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doubtful, unless a larger quantity than the usual ration had been administered.

5236. In such case, what daily allowance would you recommend?—Two or even three ounces, if the men could take it without inconvenience.

5237. (*Admiral Sir R. Collinson.*) Would you give preference to an increased quantity of lime juice, or an increased quantity of preserved potatoes?—I think the lime juice would be more efficacious than the potato; so that my preference would be given to an increase in the quantity of lime juice.

5238. (*Admiral Inglefield.*) I should like to ask if anything occurs to you, that has not been elicited from you by the questions that have been put, which will be useful to the Committee on the subject of the present enquiry?—I think all that is important has been touched upon.

5239. (*Dr. Fraser.*) You do not doubt, do you, that lime juice may be concentrated without its properties being destroyed; I mean so far as you can tell, until the experiment is made?—I do not doubt it. I think that the properties would be destroyed or deteriorated by the application of heat; everything depends upon the mode of concentration.

5240. It may be concentrated, may it not, without necessarily losing its properties?—Yes, in the absence of the application of heat.

5241. You perhaps do not know that in the preparation of some of the lime juice extensively used, heat is applied, so as to coagulate a portion of that albu-

minous principle to which you have referred, and that it is found efficient. It is quite a common pharmaceutical operation, is it not, to concentrate juices into the form of extracts, and, as far as we know, these extracts retain in every way the properties of the juices?—Their medicinal properties.

5242. What, then, is your opinion, if you have so far formed an opinion as to care to state it, of the active part of the lime juice?—That is difficult to say. I do not look upon this question merely as a chemical one. I think we cannot say that it is to the presence of this or that particular principle that its effects are due, but must take the article as a whole and speak of the result observed from its employment.

5243. Observation has, however, been made with some constituents of lime juice, has it not?—Some have contended that its action is due to potash; some have contended that it is due to the acid present.

5244. You are aware, I have no doubt, of Dr. Trotter's and Sir Wm. Burnett's experiments with citric acid, and also in the case of one of them, at any rate, with potash salts, as contrasted with lime juice itself?—Yes.

5245. Is it not the case that the results of both Trotter's and Burnett's experiments show that whereas potash salts were not found to possess any antiscorbutic property, citric acid was found to possess that property, though probably to a less degree than lime juice?—Yes.

The witness withdrew.

GEORGE BUSK, ESQ., F.R.S., *examined.*

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5246. (*The Chairman.*) You are a Fellow of the Royal College of Surgeons, a Fellow of the Royal Society, and Consulting Surgeon of the Seamen's Hospital?—Yes.

5247. I understand that the remarks which you lay before us on the subject of our enquiry will be based on papers which were supplied to you by our Secretary?—Yes.

5248. And that you desire, in the first instance, to lay before us the substance of your observations in a written paper?—Yes; irrespective of the medical opinions which have come into my hands since; so that it contains merely my own conclusions on the first perusal of the narratives by the officers of the various sledging expeditions.

5249. Will you proceed with the paper in question?—“From a careful perusal of the narratives of their respective journeys given by Commander Markham and Lieutenants Beaumont and Rawson and Aldrich, I gather: 1. That in all these journeys the first symptoms of scurvy in the respective companies made their appearance within a fortnight or three weeks from the time at which the sledges were started. 2. That from this time onwards the disease advanced unremittingly, until at last in Lieutenant Beaumont's detachment all eventually became affected, including himself, and most of them very severely, so that two of the number actually died of scurvy. In Commander Markham's party all but one were eventually affected, though the Commander himself only began to show slight symptoms of the complaint in the last day or two. Lieutenant Parr appears to have altogether escaped, or he could not have performed the remarkable feat of walking 40 miles in 24 hours, as he did when the rest of the party were nearly all helpless. One of Commander Markham's party also died. In Lieutenant Aldrich's company all were seriously affected, except himself and one other (Ayies), but even they did not escape altogether. It would thus seem that, with two or three doubtful exceptions only, out of 53 individuals all who were engaged in these three sledge excursions became sooner or later affected with scurvy; and, most probably, within little more than a month of their leaving the ship, as Captain Nares states (page 22), “apparently in the best possible health.” Now, if this is a correct statement

of the facts, it discloses a very remarkable state of things. That men in the prime of life, and full of vigour and health, and who, up to the time of their starting with the sledges, had been amply provided with every necessary requirement, should have so rapidly fallen victims to scurvy, is, in itself, a very surprising and unusual occurrence.

I do not, however, see much difficulty in explaining how such a lamentable catastrophe came about. Scurvy is essentially a consequence of defective rather than of deficient nutrition. It is a species of starvation, but which differs from ordinary inanition from want of food, in the circumstance that the wasting is not general, but in the first instance confined chiefly to the blood alone; which, from the want of a particular element, ceases to be renewed, and consequently becomes gradually more and more impoverished, and, at the same time, otherwise altered, until it is rendered incapable of supporting the various vital functions. This particular element, of the nature of which we are entirely ignorant, is, according to most authorities, afforded solely by fresh vegetable juices; whilst some are of opinion that fresh animal flesh, in the raw state more especially, and milk, are also possessed of powerful antiscorbutic properties. With regard to the last article of diet, I think there can be little doubt of its efficacy; and as to the former, there is sufficient evidence, more especially from Dr. Kane's experience, and from what we know of the habits of the Esquimaux, to justify a considerable amount of belief in its antiscorbutic power. But although the absence of the element above referred to is undoubtedly the sole efficient cause of scurvy, there are many conditions and circumstances which very powerfully contribute to the earlier or later invasion of the disease in particular cases: 1. Ample experience shows, and none more clearly than that afforded by the late Polar expedition, that, under apparently the same circumstances, individuals may vary very much with respect to the length of time during which they may be able to resist the approaches of the disease; in the same way that individuals, apparently in an equal state of health and vigour, will vary much in their power of resisting fatigue, want of sleep, deficiency of food, exposure to cold, and the like exhausting influences. In the case of scurvy, we may suppose

that individuals vary, for reasons in great part unknown, in the amount of material affording energy, the exhaustion of which is the proximate cause of the changes in the blood I have referred to. But though some of the reasons for the production of this condition are at present unknown, there can be no doubt that any conditions which involve a more than usual call upon the so-called vital powers, such as deficient nutriment, exposure to cold or to extreme heat, prolonged muscular exertion, despondency of mind, prolonged anxiety, &c., &c., must necessarily conduce to the same end. Amongst these causes might also probably be included prolonged exposure to a vitiated atmosphere, although there is no evidence that this particular condition, either on board ship or on shore, has any special influence, either in the production of the disease or in the prevention of recovery from it, when the proper pabulum is supplied. Now, in the case of the late expedition, we see many of these predisposing conditions amply fulfilled. In the first place, the crews of the ships, at the end of an unusually long and dreary season of darkness, damp, and comparative inaction, spent for the most part in an atmosphere that must have been more or less vitiated, and, notwithstanding that they had been upon what appears an ample and judiciously varied diet, including a certain amount of lime juice and preserved fruits and vegetables, cannot be supposed, from the evidence afforded to my mind by the narrative of the officers I have perused, to have been, notwithstanding their appearance of full health and strength, in precisely the same vigorous condition that they would have presented after a season spent under more genial circumstances. We may presume, therefore, that the sledge parties did not start in their full pristine vigour; but, even if they had, it appears to me that the only difference would have been that the scorbutic condition would not have manifested itself quite so rapidly. From my own experience, and, I believe, that of most others who have attended to the subject, I should say that a ship's crew in ordinary health at starting on a voyage, or most individuals even on shore, if deprived altogether of fresh vegetables or milk, or, perhaps, raw or uncooked animal food, will become more or less scorbutic within about six weeks. The period, even in the absence of vegetables, &c., would be prolonged, perhaps considerably, in cases where the rest of the diet had previously been and was exceptionally liberal and good, and the individuals were not exposed to any great fatigue or other exhausting influences. The circumstance, therefore, that in the late expedition, in the sledging parties, the disease made its appearance in some cases within a fortnight, affords to my mind almost conclusive evidence that the men were not really as vigorous as their appearance seemed to indicate. And this presumption is strengthened by the circumstance noted by Commander Markham, that the men of his party, even on the first day of his excursion (April 3), showed such signs of fatigue within six hours of their start, that he called a halt, and the tents were pitched after little more than four hours and a half of exertion, although afterwards, it is true, their usual day's work was between nine and eleven hours. Starting, then, in such a condition, the men who had been cooped up for nearly five months in a comparatively warm abode, with abundant, palatable, and nutritious food, and subjected to little or no muscular exertion, or at any rate, to none in any way comparable to that they were called upon to face, are at once exposed to exactly the opposite conditions. Instead of comparative warmth and repose, an agreeable diet, including an allowance of lime juice, and as much cheerful recreation as circumstances would allow, we find them all at once, so far as I can discover in reading the journals before me, called upon to face extreme cold, and discomfort of all kinds, together with the most unprecedented muscular exertion and consequent fatigue, upon a diet, the main ingredient of which, to

say the least of it, was to many of the men so unpalatable, that they were only induced to swallow it by the dire pressure of hunger, and to which, moreover, as it formed no part of the diet to which they had been accustomed on board ship; they must have been entirely unused, while, at the same time, they were wholly deprived of all vegetable nutriment, except 2 oz. of preserved potatoes, which in some cases seems not to have been held much more palatable than the pemmican. Nor had they anything in the shape of preserved fresh meat. Under these circumstances, it would, as it seems to me, have been marvellous indeed if scurvy had not, sooner or later, made its appearance amongst the men. I cannot conceive a combination of circumstances more likely to conduce to such a result. Here we have combined all the most effective known causes for its production and speedy development; want of fresh vegetables, or any substitute for them, combined with what must, in many instances, have been insufficient food, owing, not so much to any absolute deficiency in the amount allowed, but to the apparent repugnance of many of the men to the pemmican and bacon, in consequence of which a great part of the not over abundant rations was left unconsumed; and together with this, it should be remarked, that as soon as the scurvy had affected the gums, the men were absolutely unable to eat the biscuit, which constituted nearly half of their aliment. This deficiency of food, combined with the excessive muscular exertion and the constant exposure to extreme cold, are amply sufficient, as predisposing causes, to account for the lamentable consequences witnessed on these expeditions. The above remarks are based solely upon the accounts which I have read of the three main sledging excursions; but I would remark, in addition, that it seems that, independently of the sledging parties, some cases of scurvy had occurred on board the ships themselves, and notably, one on the 3rd of January on board the 'Discovery.' The occurrence of cases of scurvy, on board the ships, in men who, so far as I have been able to make out, had not been exposed to undue fatigue or hardship, would, in the first place, tend to confirm the suggestion I have ventured to throw out, that notwithstanding their healthy appearance they were not in a vigorous state on the expiration of their winter's confinement. In fact, Captain Stephenson (page 8) expressly states that his men, on the reappearance of daylight, looked 'pale and bleached,' or they were, in other words, as a gardener would express it, 'etiolated.' The conclusions, therefore, which I should be disposed to draw, simply from the perusal of the documents above cited, are: (1) That the winter diet, though in other respects apparently ample and excellent, and well apportioned, was, under the circumstances, probably deficient, to some extent, in the vegetable element; and that, in the absence of other fresh vegetable articles, such as raw onions and potatoes, the daily allowance of lime juice was insufficient. In the merchant service, as I have been informed, the Board of Trade insists upon every man, at the end of a fortnight from leaving port, being supplied with two ounces of that powerful antiscorbutic, whilst in the "Alert" and "Discovery" only half that quantity was issued to men placed under circumstances in which more would appear to have been demanded than in the case of an ordinary voyage. No reliance can, in my opinion, be placed upon preserved vegetables, whose antiscorbutic properties appear to me to be extremely doubtful. (2) It seems to me that, before starting on the sledge excursions, a longer interval should have been allowed to elapse between the release of the men from their winter confinement, and the period of departure on such laborious work; and that this longer interval should have been employed in the gradual inuring of the men to the unwonted labours they had to perform, and also to the complete change of diet upon which they were to subsist. It is, of course, probable that some precautions of this kind were taken; but I do not gather so from the reports before me. (3) That a supply of lime juice, to the amount

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of at least two ounces a day, should have been furnished to each sledge party that was intended to be out more than a few days. I am aware that this quantity of lime juice would be considered as far more than could be carried compatibly with other articles regarded as of greater importance. The only answer I can give to this objection would be, that, in the first place, no article whatever, except the food absolutely necessary, and without which existence could not be at all maintained, could possibly be of more importance than lime juice, where vegetables could not be obtained; and secondly, that, if this essential condition cannot be fulfilled, sledge journeys, with the conditions under which those of the late expedition were performed, should never be undertaken, except under the direct pressure of necessity. It must, indeed, be an important object, or absolute necessity alone, that, in my opinion, would justify the exposure of men to the dire sufferings, and, as it might easily happen, to the certain destruction incurred by those who are attacked by scurvy, beyond the reach of the only efficient remedy for it with which we are acquainted. The difficulty of conveying lime juice might probably be got over, were it taken in a condensed form, as proposed by Dr. Lind more than a century ago; or it might be in the form of citric acid, as was advocated by Dr. Trotter; but I doubt very much whether these substitutes would suffice, though it might perhaps be advisable to institute experiments on a large scale on the use of lime juice concentrated *in vacuo*, in which case the temperature need not exceed 150°. It is probable that Dr. Lind's 'rob,' as he terms it, was made by boiling under the usual atmospheric pressure. (4) It appears to me that it would be advisable, in future expeditions of the kind, in which a body of men are exposed to unusual conditions and accidents, that each detachment, if absent for any distance or for any length of time, should either be accompanied by a medical officer, who would be able to detect the first insidious symptoms of scurvy, and on other occasions be of great assistance in various emergencies; or, if that were not possible, that the officer in charge should be so far instructed as to be able to determine at once whether a man was affected with scurvy or not. One of the most remarkable things I have noticed, in the excellent narratives of the officers in command of the sledge parties, is their apparent ignorance of the significance of the plainest symptoms of the seaman's most deadly foe, and in face of which all other risks are altogether insignificant. This ignorance, I may perhaps be allowed to observe, might, and, in my opinion, should, have been prevented by a few "easy lessons" by the medical officers during the long leisure hours of the arctic winter. (5) It seems to me advisable that in such a service spirits should not be issued as a regular part of the rations, but should be reserved entirely for sudden emergencies requiring a short and strenuous effort, or as a medicinal agent alone. In the first place, alcohol affords no real sustenance, but rather consumes the strength; and, secondly, it is not improbable that the factitious feeling of support afforded by it, would, by its supplying a craving, further indispose a man to take as much food, to which he was not already much inclined, as he otherwise would."

Those are the principal observations I have to make. There are some additional ones which, perhaps, I may be allowed to read in order that questions may be asked upon them.

"One of the most curious, and to my mind unaccountable, circumstances connected with the sledging expedition is, not that the men should have succumbed so rapidly to their exhausting labours and exposure, but that they should have been able to endure them so long as they did, of which Lieutenant Parr's remarkable feat is a striking exemplification. I can only account for this on the supposition that the men must all have been of unusual strength and vigour; that is to say, possessed of an unusual reserve of energy, which, until it was exhausted, enabled the gallant men of the 'Alert' and 'Discovery' to support

for weeks, upon comparatively scanty nutriment, labours and exposure which, to judge from the experience of arctic travellers, such as Sir John Richardson, Dr. Rae, and others, we might have expected would have exhausted their strength in as many days. When we read in the narratives of arctic travellers of the enormous quantities of food which they themselves, and the men who accompanied them, were able, and in fact compelled, to consume, in order to resist the cold, and sustain the exertion of marching, sledge drawing, &c., exposure and exertion certainly not greater, if nearly so great, as that which the men on the Polar expedition had to sustain, and when, moreover, we consider the extraordinary quantities of flesh and blubber consumed by the Esquimaux, it would have been to me a matter of the utmost astonishment if it should have been found possible that the men could maintain their health and muscular energy beyond a very brief period upon the comparatively scanty rations they were able to consume. If we contrast the eight or nine pounds of pemmican or deer's flesh and fat often consumed by Sir John Richardson's men, if my memory is correct, perhaps not every day, but whenever they could get it, and the quantities of flesh and blubber habitually consumed by the Esquimaux, how can it be supposed that men exposed to greater cold and hardships even than the Esquimaux themselves, and at the same time having to exert, for hours together, their utmost physical powers, could possibly renew, beyond a very brief time, the energy necessary to develop the heat which was so rapidly dissipated, and the muscular force they were so incessantly called upon to expend, upon the allowance given in the diet list, even had they been able to consume the whole of it, which does not in general appear to have been the case. (2) Again, I would call attention to what appears to me a very remarkable fact. According to the 'Scale of diet arranged by the Arctic Committee' (Appendix, No. 31), it would appear that during the winter period of comparative inaction and protection from extreme cold, the amount of solid food of one kind or another, including preserved soup, allowed per diem, was one day with another, about 47 ounces, of which bread or biscuit and meat, and including the soup, constituted about 32, and with the addition of an ounce of lime juice, whilst, according to the diet list of the sledging parties, the entire daily amount of solid food was not more than 39 ounces, of which, however, bread or biscuit and meat (including pemmican under that head), constituted 34. It would thus appear that the diet was actually considerably diminished at the very time when a more abundant supply of food was imperiously demanded. Upon such an allowance, though no doubt ample enough under less arduous circumstances, and especially when we consider that a considerable part of it was not consumed, it appears to me impossible that health and strength could be long maintained, nor, as some of the cases lamentably show, even life itself, under the rigorous conditions to which the sledging parties were exposed.

In the foregoing remarks I have not referred to the experience of former arctic expeditions, not having had access to materials necessary for the purpose of comparison, otherwise my conclusions might probably be considerably modified. But in any consideration of the circumstances attending the outbreak of scurvy in the expedition of 1875-76 it would, of course, be of essential importance to ascertain, if possible, the differences of conditions which have led, as it would seem, in some cases to apparently such different results as regards the health of the crews of the ships. If it be true that on former occasions, sledge expeditions have not been attended with the same disastrous results, some sufficient cause for this difference must surely be found to exist. Was it due: (1) To any difference in the physical condition of the men at the time of their starting with the sledges, and if so, to what might that difference be attributed? Was there, for instance, any difference in the diet, exercise, &c., to

which they had been used during the winter imprisonment? (2) Was the winter confinement of shorter duration, or the absence of daylight less prolonged, or the temperature lower, &c., &c.? (3) Was the season at which the sledge parties set out later than on the last expedition? which would include the consideration of the question whether, supposing the start took place at a later period than that at which it occurred in the late expedition, the longer interval that would thus elapse between the reappearance of the sun and the time of starting may not have materially contributed to the more complete restoration of the men to their full strength and vigour from the benumbing influence of prolonged darkness and comparative inaction, and thus have placed them in a better condition to encounter the exhausting effects of sledge travelling? (4) Was this interval also employed in a previous training of the men to the new labours they were about to undertake; and for their gradual habituation to the complete change of diet and habits to which they were about to be subjected? A thorough acquaintance with these and many other points would be necessary to enable anyone to form an opinion as to the cause of the difference in the results as regards the health of the sledge crews in former and in the recent expedition."

5250. (*Dr Fraser.*) I should like to have some explanation in reference to your statement as to the differences between the ship and the sledge-party diets. I gathered from what you said, that you thought that the total quantity of food on board ship was greater than that while the men were sledging, as shown by the scale of diet?—Yes.

5251. Now, I should like to ask you, is that opinion arrived at after eliminating the water in both dietaries from each article of food; do you calculate it as water-free solids, or merely as solids, which, of course, according to the substance, must contain very varying quantities of water?—I merely take the weights as given.

5252. We have had calculations made, in which the water has been allowed for, with the general result, which will be, I have no doubt, interesting to you, that the total water-free solids, in the case of the ships' rations, was 28 ounces; whereas in the sledge rations, the total water-free solids, amounted to so large a quantity as nearly 32 ounces. That would modify your opinion, perhaps?—I did not take that into consideration. But at the same time it should be remembered, that probably more than the additional four ounces, was not consumed at all.

5253. (*Admiral Sir R. Collinson.*) You have mentioned, as one reason for the outbreak, that the nutriment was insufficient. Are you aware that the men, when they first started, did not consume the provisions that were supplied to them?—I have alluded to that. I would say that it was insufficient, not so much from any deficiency in the allowance, as that the men did not take what was allowed them.

5254. Then have you any suggestion to give the Committee as to how the crews of the sledges might be induced to take more nutriment?—By giving them food that they would find more palatable; and, when they were affected with scurvy, food that they would be able to masticate.

5255. Would you suggest what that food should be?—Of course, soft bread would be better than biscuit; but, under the conditions, that could not be obtained; and probably meat with the juices in it, instead of the dried pemmican which, of course must, and apparently did, create great thirst, could not be carried in sufficient quantity. The fact is, that I am very much inclined to believe that, under the conditions in which the sledge parties were conducted on the late expedition, sledging for any length of time was an impossibility.

5256. You are aware that Sir Leopold McClintock travelled over a distance of more than 1,200 miles, and was absent from his ship over 110 days on this diet, and yet he and his sledge crew returned to the ship without any symptoms of scurvy?—I apprehend

that they probably had not occasion to exert such very great muscular power in the dragging of sledges as the men had on this occasion. I think it probable that they did not exhaust themselves to the same extent; that their sledge travelling must have been an easier task than it was on the late occasion; and probably that the temperature to which they were exposed was very considerably less severe, as it was in a lower latitude that the journey was performed. I apprehend that on the late expedition, the cold was greater to which the men were exposed, and the muscular labour which they were called upon to exert infinitely greater for the time that it lasted; and it is the violence of the exertion that is exhausting, and not so much its prolongation, which gives time for the restoration of energy; but they were called upon to exert an amount of energy which could not be supplied by the diet they were able to take within the time that they were called upon to supply that energy.

5257. (*Admiral Inglefield.*) You stated that the quantity of lime juice which was issued to the recent arctic expedition was only half the quantity that is issued on board vessels in the merchant service, and that you think it should be doubled?—I think, if it be true that in the merchant service two ounces is the quantity prescribed, in an arctic expedition the dose should be at least equal.

5258. Then your impression is, that the lime juice which was issued to the ships' companies during the winter months, and while they were resident in the ships, was hardly enough to prepare their constitutions for the outbreak of scurvy which eventually occurred?—That is my opinion.

5259. Then, as there was none taken upon the sledge journeys, your opinion is, that it should have been issued regularly upon the journeys as well as on board the ships during the winter?—Certainly; especially under the conditions of those sledge journeys, which were more arduous than on any previous occasion.

5260. You probably have gathered from the journals, or the evidence that has been placed before you, that the difficulty in issuing lime juice on the sledge journeys was the disadvantage of taking the weight of fuel necessary for melting the water to mix with the lime juice?—Yes; I am aware of the objections that were made to it.

5261. Has it occurred to you that lime juice could be prepared in any concentrated form, so that it might be carried and used in the shape of a lozenge or a capsule by the men on the sledge journeys?—I have alluded to that point. That is an experiment that was tried by Dr. Lind about the middle of the last century; he made a preparation of lime juice in a concentrated form, making it into what he called a "rob" with sugar; a term used for a sort of preserve or syrup; but I believe, from what I have read that this was not found to be as efficacious as the fresh juice; so that I should have very little hope from any concentration, unless perhaps the juice was prepared *in vacuo*, as I have suggested.

5262. That has been put before us by another medical gentleman, the preparation of it *in vacuo*; and as the quantity, one ounce, is only the size in volume of a bantam's egg, if concentrated it might be reduced in amount to something about the size of two or three lozenges. Now, if those could be prepared *in vacuo*, do you think that the virtue of the lime juice could be retained?—That is the doubtful point; only experience could show it. It might very easily be tried in any of Her Majesty's ships by giving half the ship's company lime juice prepared in this way, and the other half in the ordinary state, and seeing whether scurvy occurred in one set of men and not in the other. The question can only be determined by experiments on a large scale.

5263. Surely an analysis would show whether the lozenges so prepared retain the citric acid?—They undoubtedly retain the citric acid.

5264. Is there any other ingredient necessary?—That is the question.

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5265. Surely if it were analysed in its crude form, and afterwards in its concentrated form, the chemists would be able to determine whether it contained all that was necessary for its antiscorbutic property?—No; we do not know at all what this antiscorbutic quality depends upon. So far as my reading and experience goes, it is to the effect, that any cooking or preparation of vegetables impairs, *pro tanto*, their antiscorbutic properties; that you should have absolutely, as it were, the living juice.

5266. Then I gather from you that even the potato itself, when preserved, does not contain the antiscorbutic properties that the raw potato would have?—Nothing like it, I should say.

5267. Then indeed we may also argue that if an analysis is made of the lime juice which has passed a winter in the arctic regions, and has by analysis been shown not to have deteriorated, yet you are of opinion that that would be no guide to us to assure us that it still retained all its antiscorbutic property?—No; but experience showed that it did. One of the most remarkable facts connected with the expedition is the extraordinary efficacy of the "Polaris" lime juice upon Captain Beaumont's men. They appear to have recovered under all other adverse circumstances, simply from the use of lime juice which had been exposed to five arctic summers and winters.

5268. And the use of fresh meat with it?—If they ate the seals raw; but I do not know that seals' meat cooked would have any antiscorbutic property excepting this: that of course scurvy may be warded off by an abundant diet for a very considerable time, if lime juice or other vegetables are supplied, and if at the same time a sufficiently abundant supply of other food is given. Lime juice or vegetables will act much more rapidly in the removal of scorbutic symptoms than they otherwise would, if the person were well supplied with nutritious food besides.

5269. But to lime juice and its free use you attribute the best remedy for scorbutics or scurvy?—In the absence of fresh vegetables.

5270. Probably you have read the account of the extraordinary drift of some of the members of the Polaris expedition, nineteen souls in all, who drifted on a floe of ice from Littleton Island, in latitude 78° 48', to about 53° N., being upwards of six months and a half upon the ice, having no ordinary diet (excepting seals' meat and walrus flesh and bears' flesh) but pemmican and biscuit, and no vegetable diet?—Yes; I have heard of that account.

5271. To what do you impute their perfect immunity from scurvy during the whole of that time?—I expect they ate their seals' flesh and walrus flesh pretty nearly raw.

5272. As a matter of fact, that was so.—I was not aware of that fact, but the tendency of what I have read in the account of Dr. Kane's expedition is to the same effect.

5273. What particular ingredients in raw flesh do you consider antiscorbutic?—It may be conceived that both fresh vegetables and raw animal juices possess, as it were (to use a vague and unscientific expression), certain vital or living properties which are more or less destroyed by cooking. That is the only explanation, if it be one, that I am prepared to offer.

5274. Ergo, you would admit that in cases of sledge journeying, if the men could consume their food raw, or the game that they killed, it would have more antiscorbutic properties than if they cooked it?—That is my impression; but I have no experience of my own in support of it.

5275. In Barentz's voyage, you will find that a number of men lived four years at Spitzbergen consuming raw meat, and to the last they had no symptoms of scurvy?—Those are instances which have not occurred to my knowledge, but they are only confirmatory of the impression which I got, especially from reading the account of Dr. Kane's voyage.

5276. At Polaris Bay they found what was termed in the account "American pemmican"; the difference between the preparation of American pemmican and English pemmican is, that they mix currants and raisins with American pemmican, and those, I presume, would contain antiscorbutic qualities?—I should think it is very probable that they would. I never heard of their being tried, but I think it is very likely that they would.

5277. I do not know whether it was so with reference to that particular pemmican which they had upon the drift, but it is quite possible, is it not?—Quite possible, I think.

5278. Have you formed any opinion as to the proper age of the men for that particular service?—Some forty years ago I worked, in conjunction with Dr. Budd, very much upon the subject of scurvy; he wrote a most valuable paper, including an able resumé of previous accounts, and in it went very much into the question of the ages of the men that were the subjects of scurvy in the Seamen's Hospital, in which I was surgeon and he was physician. And I think, if I recollect rightly, that he ascertained, after very careful investigation, that the age in which men were least exposed to attacks of scurvy was between 20 and 30, that is to say, above the age of 15; that so long as a man's age begins with 2 he is less exposed to scurvy than afterwards, and that after the age of 30 his liability to scurvy increases exactly in proportion to his age. That was the result at which Dr. Budd arrived, and, from the care which he took in preparing his statistics, and from my recollection of the way in which he worked, I have every reason to believe that it was a correct view of the case.

5279. In the "Dreadnought" doubtless there were many opportunities of observing the disease?—More than anywhere else, so far as men brought home from ships were concerned. We used at that time to have a very great number of cases.

5280. Have you seen many cases of scurvy the result of deprivation of a proper diet in tropical climates?—Nearly all the cases, with very few exceptions, in the "Dreadnought" that formed the subject of our investigations, and I believe it is the case always, were almost invariably men that had come from voyages in tropical climates. They were almost always from ships from India, or Ceylon, or Australia, and more especially from a Mauritius voyage. I remember that there were more cases of scurvy in ships from the Mauritius than from any other single voyage.

5281. Was that attributed to anything special?—That they never provided themselves vegetables at the Mauritius, at least I understood that that was the case. It was a very curious circumstance, and I do not know the reason of it. There must be abundance of vegetables on the island, but there may not have been the actual vegetables that could be taken to sea. I have seen a whole ship's company come in all affected with scurvy. I have no doubt that many ships have been lost in consequence of the whole crew being attacked with scurvy.

5282. Were they treated with lime juice when you received them in the "Dreadnought"?—Yes; when the state of their mouths wholly prevented their taking any solid food, they were put upon a milk diet, with arrowroot and beef tea, always of course with lime juice, together with oranges and other soft fruits; but chiefly lime juice and oranges, if in season.

5283. Do scorbutic symptoms in tropical climates vary at all from those in an arctic climate?—Not to my knowledge. So far as I am aware they are identically the same with those that we witnessed in the "Dreadnought."

5284. May the Committee gather from the evidence which you have given, that it is your opinion, that if lime juice had been more freely used during the winter months, that is to say, in larger quantities, and regularly issued during the sledge journeys, that there would have been a comparative, I will not say total immunity,

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but much less complaint of scurvy amongst the men?—I think that, considering the extreme cold, and the violent muscular labour that these men were called upon, as I understand from the accounts, to endure, under any conditions, I fancy that, although the invasion of scurvy might have been put off for a time, it would inevitably have attacked them at the end, say, of 60 or 70 days' sledging. I should think that two months' sledging under those conditions would have exhausted any man's strength.

5285. Instead of in ten days, as was actually the case?—In ten days it began in one of the excursions, and in none of the three expeditions was it protracted beyond three weeks.

5286. You have given the Committee a very full account of your views upon the outbreak of scurvy; nevertheless, something may still occur to you which has not been elicited by the questions which have been put. May I ask if you have anything more that you can say with reference to this outbreak of scurvy which will throw light upon the subject?—No, I cannot say that I have; because, as I said before, I have not been able to study very carefully the medical evidence; but what little I did gather from it, does not alter the views which I have expressed in the paper which I have ventured to put in.

5287. (*The Chairman.*) In view of the change of diet which took place in the sledge journeys, which had the effect of putting the men off their food for the first week or ten days, do you think that it would have been advisable to have put them on a sledge diet for some time previously to their starting on those expeditions?—I have ventured to express that opinion in the paper which I have put in, and also that they should have been gradually accustomed to the great muscular exertion which they were called upon to make; and, generally, that a longer interval should have intervened between the period of comparative inaction and that at which they were called upon to make such violent exertions, which, so far as I gather, is a shorter interval than has occurred in any other previous expedition, if I am not wrong upon that point.

5288. However expedient such a course might have been, it is not altogether clear that it would have been practicable, the season for sledging being so short that it would hardly have admitted of that plan being carried into effect?—No, that I quite understand; but the only answer which I should give to that would be, that, under such circumstances, long sledging is impossible.

5289. (*Dr. Donnet.*) I am not aware whether you know that the average age of the men was below 25, the age which you state, according to Dr. Budd's experience, as the most favourable towards giving them an immunity against scurvy; do you think that men so young as they were, were as fully fitted as older men for the work required in arctic sledging?—I should think so. I should say that a man of 25, and from that up to 35, is as capable of exertion as he can be at any period of his life.

5290. Do you suppose that the absence of light for so long a period as the men of the "Alert" were subjected to, could have had any effect towards predisposing them to scurvy?—No, I do not think so; except in so far as it may have had a depressing effect.

5291. Have you ever met with a case of scurvy in a person who has been adequately supplied with fresh succulent vegetables of good quality?—No, I never saw such a case myself.

5292. Have you had experience of scurvy occurring in persons who are vegetarians?—I never met with a vegetarian, except among Lascars.

5293. Do you know whether scurvy has a predilection for white men or black men?—I do not think so; judging from my own experience. I have seen a great many Lascars affected with scurvy. I may mention that one of the most extraordinary outbreaks of scurvy was related to me the other day by my friend, Dr. Boycott, who was in charge of the labourers that were employed I believe in

making the fortifications at Aden, when it was first occupied by the British. These men were Lascars from India, and I am afraid to say how many hundreds of them died from scurvy, although they were living entirely upon a vegetable diet, namely, rice, but without any succulent vegetables, which is a very different thing; they had only ghee, a sort of butter, in addition to their rice. As I say, I have seen many Lascars who were affected with scurvy, and I do not think that colour has anything to do with it at all. I have even seen negroes with scurvy.

5294. Have you had an opportunity of performing postmortem operations upon cases of scurvy?—Yes, repeatedly.

5295. Would you give the result of your observations?—I do not know that there is anything very particular to remark upon, except with respect to the scorbutic disease itself. The viscera generally are not affected, not diseased in any special way. The chief morbid appearances are with regard to the effusions into the cellular tissue of the body, which are the peculiar characteristics of scurvy; these are solid fibrinous effusions in the substance of the lungs, and more especially in the inter-muscular spaces, and more abundant usually in the lower extremities than in the upper; there are also fibrinous effusions also between the periosteum and the bone, constituting what we term, in surgical language, scorbutic nodes. I do not know that there were any special morbid conditions of the viscera that I have to remark upon; in fact, there cannot be much of the kind, because a man very bad indeed with scurvy, after four or five days' treatment will recover in the most marvellous way, which he could not do if there were any important lesion of the vital organs.

5296. (*Dr. Fraser.*) You yourself, I think, made microscopical examinations of the blood in scurvy?—Yes; microscopical and chemical also.

5297. And they showed, did they not, that the blood was affected in a marked manner?—The blood is very much reduced in density, the quantity of red corpuscles is very remarkably diminished, and the albuminous part has a great tendency to fibrinate or coagulate; it may be said that there is rather a superabundance of fibrin in the blood. That is proved by the circumstance that the effusions which I have spoken of are not fluid, as in anasarca effusions generally, but rapidly become solid; but of course it would take too long a time to describe all the pathology of scurvy.

5298. (*Dr. Donnet.*) With respect to the Lascars whom you mentioned as having been subject to scurvy at Aden, was there any deviation from their ordinary food at the time that they were working?—No. I understood from Dr. Boycott that they recovered when a more nutritious diet was forced upon them; but the attendants were obliged to give them soups and things of that kind in the shape of medicine, or else they would not have induced them to take them. It was entirely a matter of diet; as soon as they were properly fed, they recovered.

5299. (*Admiral Sir R. Collinson.*) You mentioned, did you not, that the blood, instead of remaining fluid, had a tendency to become solid?—If you drew blood from a man in a bad case of scurvy, which I have done for the purpose of examining, it would separate, as blood usually does, into clot and serum, as we term it. The clot would be extremely small, and it would also present the appearance of what, in medical language, is termed being buffed and cupped, which is an indication that it contains more fibrin than is the case in healthy blood. The albuminous part that transudes through the vessels, and constitutes the effusions that I have spoken of, though, of course, at first liquid, soon solidifies; which might be described as fibrination rather than coagulation.

5300. That would probably be the cause of the spots breaking out upon my body when I had the scurvy?—The colouring matter of the blood will also, in some cases, ooze through the walls of the vessels without the rupture of the coats. I believe in some

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cases of scurvy the red corpuscles of the blood become partly dissolved in the serum, and the colour may thus transude through the walls of the vessels, which is the case, generally speaking, when the density of the serum of the blood is reduced below a certain point, when it has a tendency to transude through the walls of the minute vessels, and, in the ordinary sense, to form what are termed dropsical or oedematous effusions; but in scurvy, instead of remaining fluid, this effusion rapidly becomes solid.

5301. (*Admiral Inglefield.*) From what you have just said it is clear that that condition of the blood is one of the symptoms which occur in scurvy, and that the condition of the colouring matter of the blood has a great deal to do with the respiration of good air; you have probably formed some opinion as to what the cubic space in which men live or are berthed at night should be per man?—I am not prepared to give an opinion upon that point.

5302. On board the "Dreadnought," had you any regulations with regard to the cubic space which was allotted for each man to sleep in?—They had as much space as the ship's deck would allow of. I forget what that would be, but it would be something like 1000 cubic feet for each bed on the deck, or, if they were all occupied, for each man.

5303. We have had it in evidence that on board these arctic ships the cubic space was not more than 140 feet; that, I presume, you would consider much too small a quantity?—If, like the patients in an hospital, the men were constantly resident in it, that

would be a condition in which they could not live long; but if merely occupied at night, I do not think it is a matter of any very great consequence.

5304. But there would be but small opportunity of changing the air, because the temperature outside is so low, that it is only by the process of admitting the air through crooked apertures, and so forth, and by the process of hot air stoves, that new air can be introduced for the men to respire during the night?—I can quite conceive that the difficulties would be insurmountable, but I do not think that the effects of confined air of that kind would be very important in the production of scurvy.

5305. In fact, you would say that it is not one of the principal predisposing causes?—No, I should not think so.

5306. Would you consider that that atmosphere, if it happened to be a damp one, would have a tendency in that direction?—I should take this general position with regard to these points: that any agencies of that kind, sufficiently long continued, or sufficiently powerful to affect the health generally, will, *pro tanto*, be predisposing causes of scurvy, but they are not specially so.

5307. In other words, they would sow the seeds for scurvy, to be ripened by other events still more predisposing?—Yes; as they would prepare the body for almost any disease to which a person may be afterwards exposed. Anything that lowers the general health and strength will, so far, predispose to scurvy, in the presence of the essential cause, which is an absence of fresh vegetable juices.

The witness withdrew.

WILLIAM AUGUSTUS GUY, Esq., M.D., F.R.C.P., F.R.S., *examined.*

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5308. (*The Chairman.*) You are a Fellow of the Royal College of Physicians, and a Vice-President of the Royal Society?—I am.

5309. And Professor of Hygiène to King's College, London, and Consulting Physician to King's College Hospital, and you have been President of the Statistical Society?—Yes.

5310. You further held the position of Medical Superintendent of Millbank Prison for seven years, ending in 1865?—I did.

5311. (*Dr. Fraser.*) You have paid, I believe, very great attention to the subject of public health, have you not?—I have, for many years.

5312. That subject includes the study of such questions as arise from outbreaks of scurvy?—It does. Many of my studies have borne more or less upon that subject, or on analogous subjects.

5313. You have had occasion, have you not, to enquire into the causation of scurvy in connection with various outbreaks?—I have studied that subject, and have written upon it. I had special opportunities of obtaining facts bearing upon it whilst acting as chairman of two dietary committees appointed by the Home Office; one for framing dietaries for prisoners in solitary confinement and for prisoners at public works, and the other for framing dietaries for the county and borough gaols: and, I may state, that the fact which came out from the enquiries we then made was, that wherever a body of men were deprived of the potato, scurvy always followed sooner or later, and, where any particular man was reported to have refused the potato element of his diet, not liking it, or not caring about it, there also, without any exception, scurvy broke out: that was the great fact which I had the opportunity on that occasion of learning. But perhaps I ought to add this, that, in speaking of the taking away of the potato element, I am alluding to a class of persons who have no other vegetable but the potato, with the exception always of a small quantity of vegetables, chiefly of a flavouring kind, which are put into their soup; the potato being the great vegetable element in the diet of that class of men.

5314. What deduction do you draw from that fact?—Simply the deduction which I have pointed out;

that in those cases where the potato is the only vegetable element supplied to bodies of men or to individuals, and that is withdrawn, scurvy occurs. Even supposing a fair equivalent of rice to be given in its place, that will not prevent scurvy.

5315. Potato being in the diet list to which you refer the sole representative of what are commonly called succulent vegetables?—Yes, or antiscorbutics, (if you please so to call them); the only vegetable element. Of course prisoners never have fruit. From one year's end to the other they never have anything but potatoes, and such vegetables as enter into the composition of their soup.

5316. Is it also the result of further enquiries which you may have made, that the absence of succulent vegetables from a dietary, is the usual, if not invariably, cause of outbreaks of scurvy?—It is the *vera causa*; the real cause.

5317. That is to say, you would not, in any instance, anticipate an outbreak of scurvy without the antecedent of an absence of fresh vegetables, or of some efficient substitute for them?—I should not.

5318. Do you know of any instance which appears to be at all an exception to the general rule which you have referred to?—I do not know of any.

5319. What is the substitute for fresh vegetables which has been found most efficient by experience?—I should say, to begin with, that I should class vegetables and fruits together as antiscorbutics; of course, properly preserved vegetables or fruits would be the next best substitute for fresh vegetables or fruits. Lime juice and lemon juice are both of them admitted to be antiscorbutics; and lime juice, as we all know, is given as an antiscorbutic, universally acknowledged and sanctioned, and served out, because it is an antiscorbutic, when vegetable food fails.

5320. Have you formed any opinion as to which part of the lime juice constitutes the antiscorbutic principle, or do you consider that we have evidence to arrive at a conclusion upon that point?—I should say of lime juice, as of lemon juice, that all its constituents are more or less useful in preventing scurvy, but that the vegetable acids it contains are the most important elements. It has been thought by some that potash is the true antiscorbutic element; but I myself am

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disposed to think that the vegetable acids are the elements, rather than their combination with potash. But that is not a practical question of much moment; at least I think not.

5321. When giving that opinion, of course you do not mean that the water contained in lime juice is probably of much value?—No; water is of no value, except as a solvent and diluent to the active principles which exist in the lime juice; it has no other value.

5322. I believe you have had submitted to you the scales of dietary which were used in the recent arctic expedition?—I have.

5323. Could you favour the Committee with your general views respecting both of those scales?—I will. I am obliged to assume some standard of comparison, and I take as my standard of comparison the dietary which, as chairman of the committee I have alluded to, I took a leading part in devising for the convicts employed at hard labour. It was one of the duties of the committee to devise a dietary for the future use of our convict prisons, and the course which we adopted, and deliberately adopted, in arriving at what we thought a suitable dietary was to throw aside entirely, and for reasons that we assigned, all those data that are usually called scientific. We caused circulars to be sent out to all our convict prisons, and to all our county and borough gaols, and learned what their dietaries were, what their medical officers and other officials thought of them, and what their experience was; and then, careful analysing this large array of facts, we adopted our dietary. This dietary for convicts at hard labour, such men, for instance, as are employed at Chatham, Portsmouth, Dartmoor and Portland, consisted of certain solid and certain liquid elements. By solid elements, I mean such articles of food as are presented to the prisoners in a solid form. Bread would be one such, meat would be another, the potato a third; and, taking also the meat existing in their soup and all those things that might properly be called solid elements, we gave them a dietary which contained 335 ounces of such solid food per week. Besides this, they were allowed 14 oz. of milk in the week; a certain quantity of milk being used for the chocolate, and 7 oz. of molasses to sweeten it. Therefore, there were altogether 335 ounces of what may be called solid elements of diet, or elements that can be represented in a solid form, besides the 14 oz. of milk and the 7 oz. of molasses. That, then, is the dietary which was adopted after very great care and consideration, for the convicts at hard labour. It was a reduction from the dietary which had been previously in force in more than one of the prisons. Then, with regard to the elements; if you desire to know what they were, I can give you the principal of them. There were 168 oz. of bread per week; 31 oz. of meat, eaten as meat and in soup; 4 oz. of cheese; 96 oz. of potato; 4 oz. of fresh vegetables, prescribed to be put into the soup; 3 oz. of onions, also to be put into the soup, and certain other matters; 8 oz. of flour; and 1½ oz. of suet, to make suet puddings for one day in the week. But, if the Committee wish it, I will present them in a tabular form, with a comparison of that diet with the diet of the ships in the late arctic expedition (Appendix, No. 25). I will now go on, if you please, to compare this with the dietary on board, and the dietary prescribed for the sledging parties. I will take, first of all (I am speaking of the dietary on board), the total of those things which I have classed as solids, and they amount to 321 ounces per week, as against 335; that is to say, 14 ounces less than the dietary which we laid down for the convicts at hard labour. The milk was, of course, absent, and that amounted in our dietary to 14 ounces. All the convicts had 12 ounces of milk a week and 7 ounces of molasses in the week, whereas your people on board had 7 gills of lime juice, about an ounce of vinegar and condiments, and they had their three-and-a-half gills of spirits. I now turn to the dietary of the sledging parties. I will again give the total of all the things which can be reduced to, or represented in, a

solid form. Take sugar, for instance; it is mentioned definitely as so much sugar, and I call it one of the solids. The total allowed to the sledging parties of all things that can be reduced to a solid form, or presented as such, was 275 ounces per week, besides which there were three-and-a-half gills of rum as a liquid per week. The convicts had 335 ounces, and the sailors on board had 321 ounces, but those that were sent out on sledging parties, only 275 ounces.

5324. What is your opinion with reference to the differences which you have pointed out in the total solids shown by the three dietaries?—I think that the dietary for those on board falls so little short (only by 11 ounces in the week) of that which we ourselves arranged for convicts at hard labour, that it may be looked upon, as, in point of quantity, an adequate diet; for I think it may be assumed that the labour of the convicts would be, one with another, much about on a par, in point of severity, with the labour which would have to be gone through (of course, I am merely guessing at the state of the case) by those on board outside their living and sleeping rooms in the neighbourhood of the ship.

5325. And, probably, rather less on board ship?—Very possibly less.

5326. Then you have no objection to the quantity which is represented in the ships' dietary?—I should say not.

5327. But in reference to the sledge-party dietary, have you any observations to make?—As to the sledging-party dietary, I think it is needful to go into that a little carefully, as to quality as well as quantity.

5328. Before doing that I would like to ask you, do you think it of any importance, or of much importance, that we should be able to look upon these different dietaries from the point of the total water-free food which they represent?—I do not think that it is of importance.

5329. Of course I ask the question because articles of diet differ so much in the quantity of water they contain?—Yes, they do; but the real value of an article of food cannot be measured by the dry elements of which it consists. A given weight of bread may be more wholesome than an equal weight of dry biscuit; and a given weight of fresh meat than an equal weight of preserved meat. I think then that it is scarcely worth while to inquire whether the quantity of water is the same or not the same in the sailor's and in the convict's dietary. I think it is unimportant.

5330. Will you favour the Committee with your opinion respecting the sledging-party dietary?—I think I had better take the several articles one by one. I will take the allowance of bread to the convicts, and compare that with the allowance of biscuit to the sledging parties, and the allowance of soft bread and biscuit to the parties on board. Perhaps I had better take the parties on board second, the convicts first, and the sledging parties last. We gave the convicts 168 ounces of bread per week, which is a large allowance. We gave on the Sunday a larger amount of bread than on other days, and four ounces of cheese, because on that day they were to have nothing else. It was an experiment at that time to give to prisoners dinners simply of bread and cheese; but it was acceptable to them on the whole. I mention this as accounting for the large amount of bread in that dietary. Then, in the expedition dietary on board ship, instead of 168 ounces of bread you have 112 of soft bread and biscuit taken together, the two together considered as the equivalent of bread; therefore you have a smaller quantity of that element. Then, if you come to meat, the meat of the convicts, including that eaten in the soup, was 31 ounces per week, whereas the sailors on board had, of preserved meat, corned beef, and pork, and preserved soup (counting the preserved soup as meat), a total of 112 ounces as against 31. So that there is a larger meat element in the dietary of those on board than in the convict dietary. Then in the case of the sledging

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parties, the pemmican and the bacon, taken together, amounted in the course of the week to 140 ounces, being a very large allowance of the meat and fat element. Now I come to the potato element. In the convict dietary there are 96 ounces of potato in the week. Potato does not enter distinctly into the dietary on board, but we have preserved and compressed vegetables in that dietary to the extent, we will say in round numbers, of 30 ounces per week. There would be preserved potato in that, but as I have lumped them together, the potato does not come out separately. Therefore the 96 ounces of potato may be a set off as against about 30 ounces of preserved and compressed vegetables, with seven of split peas, seven of pickles, with a little fruit and currants. But in the dietary of the sledging parties there were only 14 ounces of preserved potatoes in the week. These are the most important items.

5331. You did not refer, did you, to the bread element in the sledging parties?—Of biscuit they had 98 ounces, and that is the bread element of that dietary. 168, 112, and 98 ounces per week, of bread in the case of the convict establishment (bread and biscuit in the case of sailors on board, and biscuit in the case of the sledging parties), represent the bread element of the three dietaries. Therefore, to sum up roughly, the bread element is in excess in the convict dietary, and the meat element is in excess in both the other dietaries, but in the case of the convict dietary, the meat is fresh, and in the case of the other dietaries it is not fresh. I do not now speak of the extra fresh meat that may have been killed on the expedition, I speak only of the dietary. Then, with regard to the potato or its equivalent, the potato element is greatly in excess in the convict dietary, and it is very small in the sledging parties' dietary, being only two ounces per diem, or fourteen ounces per week, and there is no item of preserved and compressed vegetables to make up for the defect. As to any element which could supplement the potato in the sledging parties, I do not see what element there is to take its place; I do not see anything that is equivalent to the potato in the sledging parties' dietary; onion and curry powder do not go very far. In the convict dietary, therefore, there were 96 ounces of potato as against 14 ounces in the sledging parties' dietary.

5332. Previously to the enquiries which you have told us were made by the two committees, had there been any obvious faults in the dietaries of the institutions that these committees proposed to improve the dietary of, and what?—Yes; there was this objection to the existing dietaries, that in different prisons, in which the convicts had about the same amount of work to do, the dietaries varied a great deal. In some they were very high, and extras had from time to time been put on, and when once put on they were kept on; and the result was that the dietaries were thought to be, in some cases, excessive.

5333. Had they in any cases been productive of disease previously to your enquiries?—It was not alleged that they ever had produced disease. The ground of taking action was their extreme inequality and irregularity. But, as is well known to this Committee, in the year 1823 there was a great outbreak of scurvy at Millbank, the most serious outbreak that ever occurred in any of our prisons; and the history of that outbreak is particularly instructive.

5334. Would you favour the Committee with that history?—The history is given in detail in a paper on sufficient and insufficient dietaries which I read to the Statistical Society. I will put this in, if it is of any service to the Committee (*delivering in the same*), and this book also, which I published in the year 1874, on Public Health (*delivering in the same*), in which I have marked the lecture and other passages that refer to scurvy. The paper on sufficient and insufficient dietaries contains a full description of this outbreak. It was in the year 1822, that Dr. Hutchinson, who was the resident medical officer at Millbank, thought the then dietary excessive, and either had found, or thought

he had, that the men were growing too stout under it; they had become what he called plethoric under that diet, and he represented to the authorities of that day that it was desirable to reduce it. He accordingly submitted a scale of reduction, which I need not particularise; but the governing body, who were not doctors, thinking themselves, as is not uncommon, wiser than they, devised a dietary of their own; and from that dietary, unhappily, they left out the potato, or vegetable element, entirely, a small quantity of vegetables were retained in the soup; but they reduced the dietary very largely, so largely that the solid food fell from 304 to 168 ounces a week, and the only meat the prisoners got was, one ox head in the soup per week for a considerable number of prisoners. It was almost infinitesimal the quantity of meat they got. It was a largely reduced dietary, from which they had shut off the potato element; and they had a dreadful outbreak of scurvy. The disease was brought under at the time, but in the year following the diarrhoea and dysentery, which accompanied the scurvy broke out afresh. Although the diet had been improved and set to rights, still these diseases came back and were accompanied by a curious train of nervous symptoms. Of course, it might be alleged that the mere reduction in the quantity of food occasioned the scurvy; but I have shown, I need not say in what way, that that was not the case, that the mere reduction of the quantity of food would not have led to this, but the striking off of the vegetable element did. Of that I have no doubt whatever.

5335. The meat element being reduced you satisfied yourself was in no way the cause of the subsequent scurvy?—No otherwise than as part of the reduction of food. The true cause was the shutting out of the potato element.

5336. You have given your opinion with respect to the board-ship diet in the recent arctic expedition as a favourable one, as I understand you?—I should say, on the whole, taking everything into account, it is a favourable one. If I have any criticism to pass upon it, it is that I should have increased the vegetable element somewhat, I cannot say to what extent. But I should have increased the thirty ounces per week of preserved and compressed vegetables. The split peas are not antiscorbutics; the pickles, and the small quantity of fruit, which is only an ounce per week, are. Taking all these into account, I should have increased the vegetable element.

5337. (*The Chairman.*) Are you taking into account the issue of lime juice?—Yes, I am taking that into account. I should certainly have preferred an increase of the vegetable element to an increase of meat. I should, perhaps, have sacrificed a little of that rather than not have increased the vegetable element.

5338. (*Dr. Fraser.*) By the vegetable element do you mean fresh vegetables, or compressed vegetables, or lime juice?—No, I mean by the vegetable element preserved and compressed vegetables, and not lime juice. I should have given lime juice, but I should also have increased the quantity of preserved and compressed vegetables.

5339. Proceeding with the sledging dietary, what criticism have you to offer respecting it?—This, that the potato element is decidedly defective in that dietary.

5340. The vegetable element is more defective in that dietary than in the board ship dietary, is it not?—Certainly.

5341. Do you know that in the board-ship dietary, in addition to the quantity of vegetables, lime juice was served?—Yes.

5342. And you are aware that in the sledging dietary, no lime juice was included?—Quite so.

5343. Therefore that defect becomes all the more glaring, does it not, in the sledge party dietary?—It does.

5344. Are there any other points that you feel inclined to criticise with reference to the third dietary we are speaking of, the sledge-party dietary?—In the first place, I wish to observe that the total quan-

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tity of food allowed, after what I have said, must be looked upon as low; it is a smaller quantity than I think ought to have been allowed. If I may be permitted to take the convict dietary, which we arranged with so much care, as a basis and standard of comparison, I think the quantity is too small. Then, again, the potato element, or the vegetable element, especially in the absence of lime juice, was certainly too small; of that I have no doubt. Of course, I express any view of this kind with reluctance, but I come here to state what I think.

5345. This element being defective, what results would you anticipate should occur?—I should expect scurvy to have broken out sooner or later.

5346. Do you think that the defect in the vegetable or potato element, which was the leading defect, might to a great extent, or to any extent, have been supplemented by the addition to it of lime juice?—Partially, but not fully.

5347. You do not think that lime juice can be a perfect substitute for vegetable food?—I think not.

5348. Even although this vegetable matter was in the form of dry or compressed vegetable food?—Of course, if it were in the form of fresh vegetable it would have some advantage over the compressed, but that advantage cannot be exactly calculated, cannot be expressed in figures. You can only say that the fresh vegetable would be preferable to the dry or compressed vegetable, but how much you cannot say.

5349. I believe you have considered the reports and journals that have been furnished to you with reference to the recent expedition?—I have read them all through, but I am sorry to say that I have not had time to make a very thorough analysis of the whole. Still I think I can answer most of the questions you will put to me. There are some that I might be obliged to reserve, if they went too much into technicalities or figures, but I think I am pretty well informed of what has happened through the several returns forwarded to me, and the evidence given by the three or four gentlemen who have been examined by the Committee. I have had eight documents on the whole, and among them the evidence of Dr. Colan, Dr. Moss, Dr. Coppinger, and Captain Hamilton.

5350. You have, as far as you are able, acquainted yourself, have you not, with the conditions of life on board ship during that winter?—I have.

5351. Did you discover any condition, or any conditions which, in your estimation, were capable at the time of producing scurvy?—I would lay down this principle, that everything which impairs health would tend towards the production of scurvy, but not produce it; and there were circumstances on board the ships which must have impaired the health, and did do so, even though the men on their examination when they came out appeared to be in a fair state of health, with the exception of being blanched, as it is alleged they were.

5352. I presume you refer to the long absence of sunlight, to the comparative confinement on deck, to dampness, to the probable vitiation of the atmosphere, and to similar conditions?—Yes; to these and similar conditions.

5353. So far as your knowledge goes, has it ever happened that these conditions have of themselves produced scurvy?—Never within my knowledge, in the presence of a suitable dietary. But in some of the principal outbreaks of scurvy with which I am acquainted, it has been distinctly stated that the season was unusually damp and cold. In the year in which the scurvy broke out in Millbank, the winter was noted as a very cold and damp one, and the cells were alleged to have been unusually cold. The warming of the cells, and their ventilation was improved subsequent to that date, but at that date they were represented as being damp and cold.

5354. But that dampness and coldness was by no means the only cause, I suppose, of the scurvy?—Certainly not. They would not have of themselves produced scurvy. They would have impaired the health, but would not have produced the scurvy; the

true cause of the scurvy, in my judgment, having been the striking off of the potato element. The large reduction in the quantity of food (from 304 to 168 ounces per week) having, of course, contributed to the result.

5355. In fact, those other causes are what you would generally speak of as predisposing causes?—Yes. Cold may be a predisposing cause, and wet, and the reduction in the amount of food, and all of them combined; but they are not the true cause or causes, not the exciting, in the sense of trueness.

5356. They are not the necessary antecedents to scurvy?—Not the necessary antecedents to scurvy.

5357. And, indeed, their existence is not usually followed by outbreaks of scurvy?—It is not, but it is followed by disease.

5358. But by disease which is not generally scurvy?—No; a dietary deficient only in quantity, but comprising a due proportion of the potato, or vegetable, or fruit, element might issue in starvation, in consumption, or other wasting malady; it would not bring on scurvy.

5359. Are you able to give the Committee any information respecting the results that have followed the general use of antiscorbutics, especially of lime juice, upon the quantity of scurvy?—I have no experience of lime juice. That must be left to those who have experience of it; I have none.

5360. You have studied the subject, however, of the decrease of the quantity of scurvy in this country within this century?—Scurvy was formerly a very fatal malady. It was entered in the bills of mortality under the name of "the purples." It was so named from the colour, and associated with it, there was a good deal of that form of fever known as "petechial fever," in which the blood escapes from the vessels, and marks the skin with round blue spots. In our civil population, now, we scarcely know what scurvy means, it is so rare.

5361. That, at any rate, shows that it has diminished greatly?—Yes, it has diminished greatly with the improvements that have taken place in the circumstances and the dietary of the people. They have a greater command of all sorts of things, vegetables and fruits included. There was a time when vegetables were scarcely known in this country. Although fruits were never altogether absent, vegetables were. Scurvy must not only have been a common disease amongst our ancestors, but the want of vegetables must have induced a state of health rendering all severe diseases more severe.

5362. It is not a disease which is peculiar to cold climates, is it?—No, it may occur in any climate. It occurred amongst the gold workers in California, where they had no vegetable food. Although they had an abundance of all sorts of salt provisions, and an abundance of rum and coffee, yet they had no vegetable food, and, as Dr. Ober represents, they perished from scurvy. And, although I am not quite certain, I think I am right in saying, that when in one of Captain Cook's voyages scurvy broke out, it was in a warm latitude. It was an exceptionally bad season, but I think he was in a warm climate when it happened; and he, with all his care, did not prevent scurvy from happening, but it was cured when it did happen.

5363. Are you able to tell us whether the general symptoms exhibited by the disease in cold climates are the same as those exhibited by the disease in warm or temperate climates?—I believe quite the same. There is no essential difference between them that I am aware of.

5364. It is one and the same disease wherever it occurs?—Yes, one and the same disease essentially. The symptoms may vary somewhat. I have brought with me what I thought would be welcome to the Committee, two very effective enlarged drawings, for they can scarcely be called diagrams, so faithful are they, which were taken at the "Dreadnought," under the superintendence of our professor of medicine at King's College of that day, Dr. George Budd. I will leave

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them with the Committee (*delivering in the same*). It occurred to me that possibly you might like to have them reduced and so publish them, as they are illustrations of extremely well-defined cases. They have never been published, but if they were reduced, and printed in colours (and they would not be expensive, because the blotches are mainly tints of one colour) as part of your report, they would be very instructive. They might become instructive if sent round in certain cases to our ships. I may say that the only case of severe well-marked scurvy that I happen to have seen, was at the time of the Irish famine, and it presented very nearly the appearances which you have in those drawings: that is to say, it was nearly as bad, and covered almost as much of the body.

5365. As you have mentioned the Irish famine, may I ask you if you have made up your mind as to the cause of scurvy during that famine?—I have no doubt that the essential cause was the same, namely a deprivation of vegetable food, and the promoting cause or causes were all those which accompany famine.

5366. You have paid much attention, have you not, to the subject of ventilation?—I have, a good deal.

5367. It is the case, is it not, that the cubic space is an important element chiefly in so far as it greatly influences the facility with which the air can be changed or renewed; is that so?—Yes; but not only so. In both ways it is important. It is important that there should be space, and that when you have got the space, you should if possible renew the air in that space. Space is especially important on account of the difficulty which attends almost every method of ventilation which can be suggested.

5368. Have you formed any idea as to the frequency with which the air in a small chamber may be renewed in an hour in such a climate as we have in this country?—I have never formed an idea, nor cared to form an idea, about it.

5369. I suppose a vitiated atmosphere may be very injurious, may it not?—A vitiated atmosphere may be, and necessarily is, very injurious. But if you have a vitiated atmosphere acting upon persons who are not picked lives, and who are of all ages and conditions, you will have the health more impaired in such persons than it would be in the case of young or middle-aged persons who are picked lives. And if it happens that into and amongst persons occupying those narrow spaces, and breathing this vitiated atmosphere, any infectious malady gets admission, then it becomes especially fatal. Now, no such malady gained admission amongst the crews of these vessels; therefore you had not that difficulty to contend with; and they were also picked lives at an age when they could bear confinement in a close atmosphere better than if they had been less good lives, and had not been selected.

5370. In short, any vitiation of the atmosphere to which these men were subjected would not prove so injurious as it might to men who were not so young or vigorous, or who were not selected lives; I mean, persons who confine themselves in a printing office, or in a workshop of any sort, and who consist of all sorts of persons, of all ages and states of health?—Precisely so.

5371. There can be, I suppose, no question whatever, that any amount of vitiation could not have been the exciting cause of the scurvy?—It could not have been the exciting cause of the scurvy. It could only be a promoting or predisposing cause of the scurvy; it could not really and truly produce it.

5372. (*Dr. Donnet.*) What cubic space is given to each person in the gaol at Millbank?—The cubic space may be taken, I think, at about 1,000 cubic feet; and that was what John Howard thought a prisoner should have. 10 by 10 by 10, he said, was the right thing for a prisoner to have; and he was a very wise man, much before his time in all these matters.

5373. What cubic space is given to prisoners in solitary confinement?—They are in solitary confine-

ment at Millbank; they occupy the same cell day and night. When I speak of the contents of such a cell, it would be somewhere about 1,000 cubic feet; it may be somewhat less, or it may be sometimes a little more, possibly. The prisoners work in the same cell in which they sleep. They are always separated, day and night. They exercise together, and are together at church on Sundays; but that is the only occasion when they come near to each other, or are at all in contact.

5374. How many hours together are those prisoners confined?—They are confined the whole day, with the exception of the hours of exercise, and when they are occasionally taken out of their cells to be mustered for any purpose. You may say that they are confined the whole day through, with the exception of such hours as they are taken out for exercise, say a couple of hours in the day.

5375. Was the health of these men affected by this confinement?—I think not.

5376. You have mentioned that scurvy may be caused by the disuse of the potato in persons whose diet has consisted chiefly of this; can you state to what element the antiscorbutic properties of the potato is due?—I do not think we can know that with certainty; but it is probably due to the vegetable acid, or acids, which it contains; citric acid, the acid of the lemon being one of them.

5377. Do you think that potatoes, when preserved, possess equal properties with fresh?—I do not think they can be equal, even though preserved with great care; but they need not be much inferior.

5378. Does the potato when raw possess equally nutritive properties with the cooked potato?—I have never had an opportunity of ascertaining that point.

5379. Can you inform the Committee whether compressed and preserved vegetables possess the same properties as fresh vegetables?—I have no knowledge upon that point; but I should think that the fresh vegetable is the better of the two; how much better I cannot say.

5380. You mention having witnessed cases of scurvy during the famine in Ireland?—One considerable case.

5381. Have you ever witnessed cases of scurvy amongst the prisoners at Millbank?—Never.

5382. Has no case occurred since the outbreak in 1823?—Yes, but not under my notice; but Dr. Baly records an outbreak, amongst the military prisoners, which did not affect the others, and again traced it to the absence of the potato element.

5383. You state that you have no experience of lime juice as an antiscorbutic; from what you know, or from what you have read, do you consider it one of the best antiscorbutics?—Yes, I should say so.

5384. (*Admiral Sir R. Collinson.*) With respect to the sledge diet, what is your opinion as to the quantity of potato issued?—I think it inadequate.

5385. To what extent would you have increased it?—I should have increased it, subject, of course, to the question whether it could have been carried under the circumstances, but if it could have been carried, and conveniently carried, I should have increased it from 2 ounces up to 16 ounces, certainly up to half a pound.

5386. (*Admiral Inglefield.*) You have been kind enough to give the Committee valuable information with reference to the outbreak of scurvy amongst the prisoners at Millbank, and that you consider was mainly due to the want of the vegetable acid in their diet?—Yes; the potato being the chief means of supplying it.

5387. In the arctic regions, of course, there is a difficulty in supplying fresh vegetables, especially on sledge journeys, and lime juice, therefore, is a substitute for it?—Yes.

5388. Supposing that the lime juice contained all the qualities which are considered antiscorbutic, and bearing in mind that they were in such circumstances as not to be able to carry fresh vegetables, do you not consider that lime juice should undoubtedly have been carried on those sledge journeys?—I think so.

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5389. Can you give the Committee any idea of the quantity which should be taken?—The quantity would depend upon the quantity of compressed or other vegetables which might be taken with it.

5390. You have a quantity of compressed vegetables given to you in the dietary?—Yes, 2 ounces per diem.

5391. Are you now able to assign any quantity of lime juice that it would be prudent and proper to take and administer to the men daily?—I cannot fix upon any quantity, but it should exceed an ounce; I should say 2 ounces, or even more possibly. I have not been able to address myself to that question.

5392. As a matter of fact, one ounce is the quantity which was given on board ship as the ration?—I should have increased it.

5393. You would have increased the ration, and issued it daily to the men?—Yes.

5394. Have you formed any opinion as to the possibility of concentrating lime juice?—Yes; I thought it right to take that matter into consideration after something which I read in the evidence of one of the witnesses which you forwarded to me. My impression is that it might be concentrated; and my reason for thinking so is, that in the evidence to which I refer (that of Dr. Coppinger, Question 2898) it is stated that a supply of lime juice was lighted upon at Polaris Bay. It is stated that the freezing of the lime juice had practically the same effect as the freezing of salt water, in throwing up to the surface the mere water and in separating it from the other constituents. If, then, that process were to be adopted where lime juice is carried, the lime juice would retain its good qualities and the water might be poured off from it. That is the only fact I have come across which throws light upon the question; but I think it does throw light upon it: otherwise, I have no knowledge on the subject.

5395. The Committee have had put before them some samples of concentrated lime juice, in the shape of a lozenge, specially prepared, with the view of carrying it upon an arctic sledge journey; four of these lozenges are considered to be equivalent to a ration of lime juice of one ounce. Will you taste one of them (*handing a lozenge to witness*)?—I like the taste.

5396. We have desired that those should be analysed, and, admitting that we find that they contain the essential parts of the lime juice to act as an antiscorbutic, and that they have lost nothing in the process of being formed into a lozenge, would you recommend that lime juice in that form should be carried by sledging parties?—Most assuredly; I have no doubt about it, assuming what you say.

5397. And that will, of course, be a thing which one cannot really decide upon, until the result of the analysis, which will decide whether it contains the elements or not?—And, perhaps, I may add, that we medical men have experience of all sorts of extracts obtained by evaporation, *in vacuo*, at low temperatures, in which the qualities are admirably preserved. Some poisonous extracts, as medicines, when so prepared, retain all the properties of the plant from which they come.

5398. On the other hand, it has been suggested that by the evaporation necessary to reduce it to that compressed form, it would lose some of its constituent parts, but that those again may be preserved if it was evaporated *in vacuo*; do you think so?—I think so; I think that the essential properties would be preserved in that way.

5399. Then, in that case, you have little doubt but that lime juice might be concentrated in such a form as to be carried conveniently, and used daily by the men without any extra weight being added to the sledges?—I think that this lozenge solves the difficulty, on the supposition that, when analysed, it is found not to have lost any of the constituent parts of the lime juice.

5400. With regard to the age of the men who should be selected for such extraordinary services as are required of them in the arctic regions, have you

formed any opinion?—Yes; I have no doubt upon that point, that the men selected for such service should be at least 27 years of age, that being the age at which, according to Quetelet's enquiries, the body attains its full growth. I should certainly prefer 27.

5401. If that is the minimum, what would you give as the maximum?—I should say something like 37. Take 10 years from 27 onwards. I do not attach much importance to the figure seven in either case, but something of that sort.

5402. Is this age selected with the belief that the constitution is more formed, and better able to withstand the rigours of an arctic climate?—It is.

5403. Is there anything which occurs to you, any information which you could give the Committee upon the subject of the present enquiry, which has not been elicited from you by the questions which have been put by the members of the Committee?—I think there are several points, and I will mention them, and if you please to put any questions upon them, I shall be prepared to answer them. I would rather follow your lead than force anything upon the Committee. I think that the subject of cubic space should be entered into a little further. What the sailors had on board ship would certainly be inadequate for the preservation of health, even in picked men, unless they were leading such a life as an agricultural labourer leads, who very often sleeps in an atmosphere of much the same sort. He gets up in the morning, goes to work, works away through the day, and, as it were, works off the injury the close air of the night has done him. But in all cases in which there is much confinement, and a life of insufficient exercise, such space as 150 or 200 cubic feet is inadequate to the full preservation of health. At the same time, of course, it must always be a practical question whether you can so manage matters that the space shall exceed that; you have got to consider the size of your ship and the number of your crew, and that must regulate, of course, very much the space that you can allow your sailors.

5404. (*The Chairman.*) Of course it would modify your opinion on the subject considerably, if you were made aware that it was particularly insisted upon in both ships that the men should be employed every day outside the ship for as large a number of hours as circumstances would permit: and we understand that, as a rule, they were generally employed for five or six hours?—The question that would arise under these circumstances, is, whether, taking an agricultural labourer, who occupies a similar narrow space at night, as a sort of standard, your sailor on board ship would do as wholesome work as an agricultural labourer would do, or whether that work would not be so much or so wholesome, especially if the weather outside was very unfavourable to them. Whether, in fact, a seaman would not suffer more than such an agricultural labourer would suffer. Of course, one cannot settle a question of that sort, get as near to it as we may.

5405. Will you proceed to the next point, ventilation?—The difficulty of the efficient ventilation of very narrow spaces may be put down as next to insuperable, and the difficulty would, if possible, be increased when the external temperature is low; because then the people who should be admitting fresh air for their own sakes are very susceptible of that movement of air which they call a draught. You cannot, therefore, ventilate places in which people are living and sleeping, by the introduction of cold air from without. They will not let you do it. If the air is very distinctly cold, and if the draught is strong, they will shut up the ventilators whatever they may be. That has always been found a great difficulty in barracks, in the dwelling-houses of the poor, in model lodging-houses, and other such places. The inmates are so anxious to secure warmth, and so fearful of encountering cold, that they do all they can to render the ventilation impracticable.

5406. (*Dr. Fraser.*) Of course, it is important, even in confined spaces, that the air should be renewed?—Clearly most important.

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5407. I think I gathered from what you said that there is great difficulty with this feeling of draught, in the admission of cold air?—Yes.

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5408. Might not the renewal of the air to some extent be increased, were the air admitted from the outside heated previously to its distribution in the living place?—Undoubtedly it might.

5409. And that, do not you think, especially in the arctic regions, would be a very important addition to the ventilating apparatus of a ship?—Very important. I would venture to add one word about a cause which greatly increases the difficulty of ventilating such places as ships' cabins. The difficulty is very great of ventilating spaces where there are no opposite windows, or openings to correspond to opposite windows, to enable you to blow the space through and through; you must of necessity ventilate by some contrivance such as wind-sails, by which you may get air to blow down. There is a practical difficulty about ventilation in all cases, but it is at its maximum where you cannot contrive to get opposite openings.

5410. (*The Chairman.*) Is there any other point besides ventilation upon which you could give the Committee information?—I should like to insist upon the importance of training, before setting out on long expeditions: and I think that the importance is twofold; first of all, to prepare men for the exertions that they have to undergo, by similar exertions upon a lesser scale, which is one advantage; and the other is, that if you find, on experiment, that certain men do not practically bear what others can bear, you may substitute better men for them. I think that is a point which should have been attended to. But perhaps I may be permitted to add that, having carefully looked at the papers forwarded to me, I have formed this impression that men were never yet exposed to such intense cold, wet, fatigue and privation as the sledging parties had to go through, especially in the northern sledge expedition. It seems to me to have been the very maximum of human exposure. Under such circumstances, scurvy was to be dreaded, and there is possibly, and even probably, no dietary which could be prescribed, nothing that the men could have taken with them, that would certainly have prevented the occurrence of scurvy. No antiscorbutics, I believe, could have been strong enough to prevent with certainty the occurrence of scurvy, sooner or later. But the advent of the disease might be greatly postponed by such means.

5411. (*Admiral Inglefield.*) Nor, according to your idea, in sufficient quantities?—You could not carry them in sufficient quantity to make you secure against scurvy.

5412. You mean for giving supply during the winter, and a supplemental supply during the whole sledge journeys?—Yes.

5413. (*The Chairman.*) Is there any other point which occurs to you?—I should like to add to what I have just said of the great difficulty of preventing scurvy in cases of extreme exposure, that the dietary on board the two ships did actually prevent the disease except in one solitary instance. So that a dietary abounding in those articles of food that are usually deemed antiscorbutic may be reasonably expected to prevent, or greatly postpone, the advent of scurvy. It would not be good policy to throw aside all our experience of antiscorbutics, and assume, with Dr. Black, that a liberal supply of blubber would prove the real preventive of scurvy.

5414. Do you think it would have been expedient that for some time previous to the departure of the sledge parties, they should have been dieted on the provisions provided for their expeditions, inasmuch as we have noticed that for the first week or ten days they did not take kindly to their new food?—I think that would have been important.

5415. (*Dr. Fraser.*) I do not know whether you have thought of the matter, but do you think that alcohol is a valuable substance to use in sledge parties and expeditions?—I am glad that you have asked

that question, for I have thought over it, and I think that the evidence seems to show that tea, partly on account of its own properties, and partly on account of the warmth that accompanies the drinking of it, is to be preferred very much to alcohol in any form; but I am not quite so certain that at night, before going to bed, alcohol is to be condemned in all forms. If I gave it at all, I should certainly give it before going to bed, for it is, in many cases, the finest narcotic we have; and I have had experience of it myself in typhoid fever. I thought I was about to lose a patient, a delicate woman, and I gave her half a tumbler of brandy. In less than a minute she threw herself on her side and went to sleep. It is an excellent narcotic, so that I should certainly say it should be taken by sledging parties, to be used with discretion, or when it appears that through excessive cold the crew are not sleeping. Then it might be very beneficial. I would observe, as bearing upon this question, and as touching also the question of the use of tobacco, that there is a good deal to be said in favour of those things that the men like, and especially tobacco, for there is no doubt whatever that it is one of the greatest comforts to men of that class to be able to smoke. Prisoners, who cannot have tobacco unless they steal it, who never get it except in that way, will go through almost anything to get a smoke of tobacco. That class of people are very fond of tobacco, and, indeed, we know that all classes are getting to be fond of it, but those people are especially so; so that in devising dietaries it is quite important to take into consideration the things which the men like. If they like their grog, and if they like their tobacco, that is a reason why they should have grog and tobacco, over and above the question of health. There was another point which occurred to me to notice as I read the evidence. Some observations were made on the subject of weighing the men; and I think I can say something upon that point, which it is well that the Committee should be aware of. I have entered a good deal into that question of weighings, and it is perfectly certain, as the result of what I know on the subject, that weighing is not so good a test as it is thought to be of the effect of a dietary upon the persons who are taking that dietary. The experiments made at Pentonville Prison, under the direction of Sir B. Brodie and my friend Dr. Owen Rees, lost much of their value through the want of the knowledge we now possess of the causes (many of them obscure) which affect the weight of men kept for long periods on the same food. In these experiments it was assumed that food was the one thing which influenced the weight. Their experiments, therefore, were faulty and led to faulty results, as I have had occasion to point out. I have had occasion also to look somewhat narrowly into what are usually called scientific data. I allude especially to certain statements, as to the precise quantity of certain gaseous elements that ought to enter into the food of man. When these scientific data are carefully looked into, some of them are found to be very unsound, and some of them very insufficient. We have a few most careful and satisfactory experiments on individuals, but the experiments and observations which relate to masses of men are very unsatisfactory. I wish it therefore to be understood, that in what I have said I have gone entirely upon what may be called a vulgar experience rather than upon any scientific data whatever. These I distrust, and I have had special reason to distrust them on two occasions. I was sent down once to Portsmouth and once to Chatham, to investigate a question with which the dietary was closely connected, and I was then convinced, that by relying too much on so-called scientific data very serious errors had been committed, and that on the whole those data are not satisfactory. We were very much urged, when we were upon this matter of diets, to take into account these scientific data, but we assigned our reasons why we mistrusted them, and we did not use them.

5416. (*The Chairman.*) You have been good

enough to supply us with, 1st, a tabular comparison of the expedition dietaries with that established for the convict prisons in the year 1864 (Appendix, No. 25); 2ndly, pictorial representations of two severe cases of scurvy in the "Dreadnought"; 3rdly, a

work which you published in the year 1874 on public health; and 4thly, a paper on dietaries, which you supplied to the Journal of the Statistical Society of London, in September, 1863?—Yes, I have had much pleasure in doing so.

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The witness withdrew.

Adjourned to to-morrow, at 11 o'clock,

FRIDAY, 26TH JANUARY, 1877.

PRESENT:

ADMIRAL SIR JAMES HOPE, G.C.B., in the Chair.

ADMIRAL SIR R. COLLINSON, K.C.B.

VICE-ADMIRAL E. A. INGLEFIELD, C.B., F.R.S.

JAMES J. L. DONNET, Esq., M.D., Inspector-General of Hospitals and Fleets, R.N.

THOMAS R. FRASER, Esq., M.D., F.R.S.E.

H. J. VANSITTART NEALE, Esq., Secretary.

THOMAS BUZZARD, Esq., M.D., F.R.C.P., *examined.*

5417. (*The Chairman*). You are a Fellow of the Royal College of Physicians, and Physician to the National Hospital for the Paralysed and Epileptic?—I am.

5418. You are also the author of an article on Scurvy, in Reynolds' System of Medicine?—I am.

5419. (*Dr. Fraser*.) You have, I believe, devoted a considerable amount of attention to the subject of the general etiology of scurvy, have you not?—I did some years ago.

5420. And you have had, therefore, occasion to look into the history of various outbreaks of scurvy?—I have.

5421. In fact, to study the history of the subject generally?—I have.

5422. Would you shortly inform the Committee of the conclusions to which you have arrived from that study as to the etiology of scurvy, illustrating, if you possibly can, any conclusion which you have arrived at by the incident on which your conclusion is based?—I have arrived at the conclusion that scurvy is a peculiar state of mal-nutrition, supervening gradually upon the continued use of a dietary deficient in fresh vegetable material, and tending to death after a longer or shorter interval, if the circumstances under which it arose remain unaltered.

5423. Will you favour the Committee with any illustrations showing that in the presence, for instance, of an abundant dietary of meat and a deficiency of vegetables, scurvy has originated, or any similar illustrations?—In the great potato famine about the year 1846, scurvy occurred very much in Ireland and Scotland and England, and there are numerous records of outbreaks of the disorder. Amongst other illustrations, Dr. Lonsdale tells us, in the Edinburgh Monthly Journal of August, 1847, that in a great number of the huts occupied by railway excavators, amongst whom there were numerous cases of the disease, some of which proved fatal, he saw the men breakfasting off beef steaks or mutton chops and bread; the animal food was taken in large quantities, but there were no potatoes or fresh vegetables. Again, Dr. Dickinson, in Cumberland, describes, that although scurvy was rife in Cumberland, at Workington the disease did not show itself, and he adds that vegetable food was more abundant there than in many situations, for instance, turnips, of which large quantities were used. Dr. Shapter remarks, in reference to the cases of scurvy observed by him in Exeter, that the only difference from the usual diet of the sufferers consisted in the absence of the

potato. So also, Dr. Ritchie gives his experience in the Royal Infirmary of Glasgow, that in all but a fraction of the cases, in which they were deficient, the patients had been exposed for months to a total deprivation of fresh succulent vegetables. Dr. Curran, in his description of the occurrence of scurvy in Ireland, writes, "In four-fifths of the cases reported to me, bread and tea or coffee was what the patients had been living on when attacked; the others had been using grains of various kinds, or grains and flesh or fish, but in no single instance could I discover that green vegetables or potatoes had formed a part of their regular dietary."

5424. Do you remember if, during the Crimean War, any striking illustrations were afforded, bearing upon the etiology of the disease?—The most striking that I remember was in reference to the French army. The French army was unprovided with lime juice, and no less than 23,000 cases of scurvy are recorded as occurring among the French troops. From the month of February, 1855, fresh meat was supplied to them, at first twice, and then five times a week. The supply of bread was irregular, and fresh vegetables formed no part of the rations; rice was allowed, and occasionally dried vegetables, principally peas, beans, and lentils, but in small proportions. The disease (scurvy) first showed itself in the winter of 1854-5, and committed terrible ravages. As the season opened, and the earth began to bring forth vegetation, scurvy diminished. The troops were encouraged to collect herbs, and especially dandelion, which was very plentiful. The improvement which took place under these circumstances was very marked, and there is no reason to believe that it would not have been permanent had the supplies continued; but as July approached, the rays of the sun dried up the surface of the ground on which the troops were encamped, no more dandelion was to be obtained, and in the course of three months, the finest and warmest in the year, no less than 5,000 cases of scurvy occurred. The Sardinian army, which arrived in the Crimea in the early summer of 1855, was very generally affected by scurvy, and its ravages were checked by the vegetables supplied to the troops as the season advanced. The Turkish army, under His Highness Omer Pasha, with which I served, was very severely affected by scurvy. I would say the nominal dietary of the Turkish army in the field was a fairly adequate one. It embraced bread and yab, which is a kind of butter made from mutton fat, meat, and rice, and haricot beans, but during the campaign

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in Mingrelia in the autumn of 1855, and winter of 1855-6, a very small portion of that dietary ever reached the troops, and they lived mainly on biscuits and a little rice, and a little yah. They had no fresh vegetable food, and scurvy broke out amongst them in a very terrible form. I cannot give you the numbers, as I have no statistics, but many hundreds of cases of scurvy came under my own observation in Trebizonde, where we had prepared a hospital for the reception of troops as they came down from the front. Many of these cases died whilst being carried up to the hospital from the ship which brought them, and many died also immediately after their admission. And on the other hand, those who were immediately put upon a vegetable diet (that is to say, they had oranges and lemons distributed to them at once *ad libitum*) for the most part rapidly recovered.

5425. What you last tell us, I understand, is to a great extent the result of your own observation?—Yes, of my own observation. I should say that it is within my knowledge, too, that in the preceding winter the Turkish troops who were then stationed at Eupatoria, in the Crimea, had suffered severely from scurvy, and at that time they had abundance of fresh meat. Their general dietary was very good indeed, but they had no vegetables. I will read an extract from a paper by a brother officer of mine, Dr. Bird, who was at Eupatoria, and relates what he himself saw. Speaking of the Turkish troops in that winter at Eupatoria, he says, "They fed on good sound biscuits, boiled rice, fresh meat twice or three times a week, salt meat was unknown amongst them; they were not overworked or idle, and they were in excellent spirits at having beaten the enemy, and yet I found on examination, that on an average three men out of four on duty in the spring of 1855, were more or less afflicted with scurvy." I should say, leaving that part of the subject, that I have myself seen, amongst the poor in London, cases of scurvy where fresh vegetables had formed no part of the dietary.

5426. Do you mean where the dietary was not a starvation one?—The dietary in those cases had really been a starvation dietary.

5427. In the cases in the Irish famine to which you have referred, no doubt in many instances the dietary there was a starvation one also?—No doubt.

5428. But in most of the other cases, if not in all excepting those two, the dietary was in no case a starvation dietary, I mean so far as quantity of nutriment was concerned, not as to the proportion of the proper elements of food?—I have referred to many cases in which the dietary was quantitatively sufficient.

5429. You have studied, of course, the symptoms of the disease as they occur in various parts of the world, from published records?—Yes.

5430. Have you been able to discover any distinctions in the disease as occurring, say in tropical, as contrasted with Arctic regions?—I have not.

5431. There is no apparent distinction in the symptoms, therefore I suppose you have not the least doubt that the disease is one and the same wherever it occur?—I have not the least doubt of it.

5432. Are you equally of opinion that the causation is the same, so far as the essential antecedent is concerned, wherever it occur?—I am.

5433. And that essential antecedent, in your opinion, is what?—It is the absence from the dietary of something which is contained in fresh vegetable food.

5434. That being so, for what reason is lime juice administered?—Because experience has shown that lime juice, in the absence of other forms of vegetable food, will prevent the occurrence of scurvy, under circumstances where scurvy would have occurred without the addition of lime juice to the dietary.

5435. Its use is, in short, as a substitute for fresh vegetable food?—Yes, it is a fresh vegetable food.

5436. Although there may be, in your opinion, one essential antecedent, there are numerous causes which favour the occurrence of scurvy, are there not?—I think that starvation hastens the appearance of symptoms of scurvy—I mean by starvation a quantitative deficiency in the food generally—I think that a man will show symptoms of scurvy more rapidly when his food, altogether, including this particular element, has been very deficient, than when the food generally has been less defective.

5437. Do you think that a defective dietary accompanied with a sufficiency of fresh vegetable food would result in scurvy?—No, I do not.

5438. In short, a man may be starved without scurvy?—Yes, certainly.

5439. Although it is essentially a disease of nutrition?—Exactly so.

5440. What is your opinion in reference to climate exposure as a predisposing cause, to use a technical phrase?—As the result of my reading and enquiries generally upon that subject, I have not been able to satisfy myself that any marked influence is produced by differences of climate. For example, scurvy, no doubt, has been rife over and over again in Arctic Expeditions, but it has equally been rife in merchant vessels, ill-found, and trading to the tropics. Scurvy has been quite as violent in intensely hot regions as ever it has been in intensely cold regions, and has appeared apparently as quickly in the one as in the other.

5441. You have not been able to arrive at the conclusion that intense cold in itself is a specially predisposing cause to scurvy?—No, I have not.

5442. It is possibly a cause of reducing the standard of health, however, is it not?—Possibly.

5443. And may it not, in an indirect manner, be a predisposing cause in so far that intense cold will require some special addition to the nutriment in order to maintain the body in health, and the power of assimilation and digestion being of course limited, that nutriment may not be supplied, however perfect the dietary is?—Yes; I think in that way it may.

5444. That is in the same direction, is it not?—Yes.

5445. What is your impression respecting the predisposing influence of long continued confinement, with a moderate amount of exercise?—From the fact that scurvy has appeared so frequently under circumstances when that particular condition did not prevail, I am unable to feel satisfied that it has any direct bearing upon the production of scurvy. To give an illustration, scurvy will occur, and does frequently occur, in Australia, in the bush, amongst shepherds and pioneers who are taking great exercise, who are so little confined that they bivouac at night, and have no dwelling at all, who are not cooped up, and whose condition generally, therefore, is really absolutely removed from that to which you refer. Their diet has consisted of meat and tea and damper, but they have had no fresh vegetables. It is difficult, therefore, I think, to feel satisfied that confinement has any direct bearing upon the production of scurvy. That it would affect the general health, I suppose no one can doubt.

5446. And by affecting the general health, no doubt if what you consider is the necessary antecedent of scurvy were added, then scurvy might more readily occur, might it not?—Yes.

5447. If you were to contrast men in confinement with men not in confinement, and gave to both what you imagine to be the necessary antecedent, would you imagine that with a man in confinement scurvy would sooner occur than with a man not in confinement?—I should certainly think so.

5448. In fact, the result generally of such investigations as we possess upon the subject, is that confinement is only a predisposing cause. I refer especially to investigations in the Millbank Penitentiary, and by Sir Robert Christison, at Perth, with

which you are quite acquainted, where it was found that scurvy having appeared amongst the prisoners, those prisoners were affected in the greatest number who had been longest in confinement?—Yes.

5449. If confinement in itself may be a predisposing cause of scurvy, I suppose confinement in the absence of sunlight would *a fortiori* be a predisposing cause?—Yes, I should say so.

5450. Still, you do not regard these antecedents as by any means necessary antecedents?—No, I do not.

5451. What has been the general result of your enquiries respecting the efficacy of lime juice, both as a prophylactic and as a cure for scurvy?—I would take first the latter question, the cure. The effects of lime juice are of extraordinary rapidity. I have seen patients materially altered in their condition in a few hours by the administration of lime juice or lemon juice, and I have no doubt about the extraordinary efficacy of lime juice as a cure for the condition which we call scurvy. As regards the question of prevention of the appearance of the symptoms of scurvy, I also think that lime juice in sufficient quantities is adequate to the prevention of scurvy. I think that the amount of the ration which is commonly given, namely, one ounce daily, which is the ration of the merchant service, is adequate to the prevention of the appearance of scurvy in voyages of the length which are generally taken. I believe that the voyages now-a-days without touching land rarely exceed three or four months, and I should say that the ration of an ounce of lime juice daily is generally sufficient to prevent the appearance of scurvy for that time. In sufficient quantity, having relation to the time during which persons are cut off from ordinary supplies of vegetable food, I consider lime juice to be a reliable preventative of scurvy.

5452. I understand that you have had laid before you many of the papers connected with the recent arctic expedition?—I have.

5453. And I need hardly ask you whether or not you have carefully looked over these papers?—I have, most carefully.

5454. Perhaps you are able, from your examination of these papers, to favour the Committee with some general account of the impressions which have been produced upon your mind by your examination of them?—From the papers which have been laid before me I gather the following facts, speaking very broadly:—First, that the first cases of scurvy were recognised on board the ships "Alert" and "Discovery" about eight months or more after the vessels had quitted England. During this period the crews had been dependent upon the provisions carried on board for their sustenance. The daily ration of lime juice was one ounce, and such vegetables as were consumed were in the form of preserved vegetables. Secondly, that one month before the sledges started the allowance of lime juice was doubled. Thirdly, that no lime juice, and but two ounces of preserved potatoes per man per day was carried in the sledging expeditions. Fourthly, that within a few days of leaving the ships numerous cases of scurvy, many in a severe form, and some fatal, occurred amongst the crews of the sledges. Fifthly, that with the exception of Lieutenant Beaumont, who suffered from the disease, but not sufficiently to prevent his walking, and, I think, helping to draw the sledge, all the officers escaped. I think that represents essentially the facts of the case, speaking in very general terms. Now, I think I see in the length of time that elapsed from leaving England before the first cases of scurvy were recognised, a fact which has an important bearing upon the occurrence of the disease. It was at least eight months, during which the principal antiscorbutic was an ounce of lime juice daily. My belief is that an ounce of lime juice daily, even with the addition of the small amount of preserved vegetables prescribed in the dietary list arranged by the Arctic Committee, although nearly sufficient for the purpose of adding this necessary element of food, was

not quite sufficient; and I believe that that slight insufficiency, although for a considerable time it will fail to allow of very appreciable symptoms of scurvy manifesting themselves, yet that slight insufficiency is, if one may so express oneself, cumulative; that the deterioration of nutrition goes on, getting gradually—slightly, no doubt, but gradually and regularly—more marked day by day. And one would imagine that that must be the case, if we suppose that, to begin with, this particular material which is found in fresh vegetable food is slightly insufficient. The working capability of the body—I mean particularly as regards the processes of assimilation—is *ipso facto* slightly diminished; and then, day by day, the power of exactly complementing the loss sustained by the processes of repair in the tissues is slightly diminished; so that, in process of time, under a dietary, for instance, which includes an ounce of lime juice daily, I can understand scurvy developing itself in a severe form. I lay great stress upon that "in process of time," and my reason for that opinion is founded upon this, that vessels, after they have been out for many weeks, and the crew doing very well, upon this ration of lime juice, do frequently develop cases of scurvy, which are cured immediately by increasing the allowance of lime juice. Now, an instance of this kind, to give one example, occurred, which is related in Dr. Aitken's book on "Medicine." It appears that, in 1794, His Majesty's ship "Suffolk," from England to Madras, was out twenty-three weeks without calling anywhere. The allowance of lime juice was two-thirds of an ounce daily per man, and it was mixed with grog and two ounces of sugar. Not one man was lost, and there were only fifteen on the sick list. Scurvy appeared in a few men on the voyage, but disappeared on increasing the lime juice. I may say that, as the result of my study and inquiry, I have frequently found that an allowance of about that amount, whilst apparently sufficient to preserve men in health for several weeks, gradually appeared to lose its efficacy. I believe that the loss of efficacy has been only a relative one, and that the cause of the outbreak of scurvy has been that which I have stated, namely, that the antiscorbutic has been from the very first, slightly, perhaps, but really, deficient. It has been slightly inadequate from the very first, and this is the result of that inadequacy; there has been a gradually-accumulating deterioration of the nutrition of the body. When the sledging parties started, the men became suddenly exposed to three very important agencies. In the first place, their lime juice was omitted altogether. In the next place, they were exposed to muscular exertion of a very severe kind, and muscular exertion, it is sufficiently notorious, necessitates, if health is to be preserved, an increased instead of a diminished quantity of food of any kind. In the third place, probably the additional exposure to cold, which generally implies a demand for more food, was another agency. I think that these men, when they started on the sledging expeditions, were already scorbutic, and that they broke down with exceeding rapidity, on account of the taking away of even the inadequate amount of the required element from their dietary, and that the qualitative deficiency of the food was enormously intensified by the circumstances under which they found themselves in the sledging expeditions. I will put it in another way. I think that if these men could have been suddenly transported on to the ice from their ordinary natural life in England, and exposed to the cold, and the muscular exertion, and the absence of lime juice to which these men were exposed, they would not have broken down with scurvy at the early stage at which many of the men broke down in these sledging expeditions. Had they continued long enough, no doubt they would also have broken down on such a dietary, but they would not have broken down in the few days which were sufficient to cause the breakdown in many of those cases. I think

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that the comparative immunity of the officers has an important bearing upon this matter. Although I find no reference to the subject amongst these papers, I presume, from what I have seen of board ship life, that the officers' mess was not confined to that dietary scale which was drawn up by the Arctic Committee, but that there were other elements of food which were taken by the officers on board the ships, at all events.

5455. We have it in evidence that they had wine, and more vegetables, fruits, jams, sardines, butter, cheese, milk, and things of that kind?—I have no doubt whatever, myself, that it was the addition to the dietary which was furnished to the officers by these materials, namely, fruits, milk, butter, and additional preserved vegetables, that prevented this scorbutic taint in them, and enabled them to encounter the arduous exposure of the sledging expeditions without breaking down with scurvy as the men did. It may be asked, what evidence have you that the men were scorbutic in the ship? It is not very easy to answer that, because apparently the medical officers were not accustomed to scurvy, and the knowledge of the disease seems to have gradually impressed itself upon them, but at first they do not appear to have been very keenly on the look-out for it, so far as I can gather from the evidence. But I noticed, I think, that more than one medical officer spoke of the men in their winter quarters as having been anæmic. I am aware that it was also stated by the commander of the "Alert" that when these men were examined for the sledging expeditions they were a peculiarly fine looking body of men, but from my experience of scurvy and general study of the subject, I know that a highly scorbutic taint may exist before the objective symptoms are very strongly marked. It is customary, for example, for medical men very often to consider a peculiar condition of the gums as being a necessary part of scurvy, and if that is not complained of, the idea that they are looking at a case of scurvy will not enter their minds. But this is by no means a necessary feature of scurvy, and I have seen men die of scurvy with their gums unaffected. Pallor is one of the first symptoms of scurvy, according to my observation; pallor, weakness, listlessness, and want of energy, are symptoms of scurvy of the earliest kind, and these manifestly, if they prevailed generally, would be very likely to escape notice. If you contrast one man who presents symptoms with others who are quite well, you are struck, perhaps, by the contrast, but where all the men are under the same conditions, they might have a good deal of pallor, and debility, and apathy, without these being so prominently marked as to attract the examining officer's attention. It is only when typical examples of the disorder have occurred, and its appearance is being anxiously looked for in others, that scurvy, in its early stage, is easily recognised. When not expected it is extremely likely to be overlooked. I remember that when the first case of scurvy came before me in the East—and it was a confirmed case, too—I was indebted to a brother officer, who had seen the disease before, for making a correct diagnosis. I may say that the question suggested itself to me whether there was any evidence that the lime juice was deteriorated in any way, and was not of good quality; but I came to the conclusion that there was no evidence to that effect, because, when the men with very severe scurvy got a considerable quantity of lime juice they rapidly recovered, which they would not have done had the lime juice been of bad quality. It may be asked, how do you know that it was the lime juice which caused the rapid recovery of these men? and my reply is, that the only articles of dietary which were given to them, with the exception of preserved vegetables and fruits, were inadequate to the prevention of scurvy, as is

notorious by our records, and therefore presumably inadequate to its cure.

5456. I gather from what you have told us, that you have the impression, from the examination of the papers which have been laid before you, that the disease was in some degree present in many of the men before the sledge parties departed from the ship?—Yes.

5457. And that probably the reason why it was so present is, that the quantity of lime juice, looking upon lime juice as a substitute for fresh vegetables, was not quite adequate?—Quite so.

5458. We have it in evidence that in the case of one ship, the "Alert," the quantity was increased to two ounces, that is to say, was doubled, and maintained at that double dose for one month previously to the starting of the sledge parties; do you think that this increase would have at all influenced either the rapidity of the occurrence of scurvy, or the number of cases of scurvy, in the sledge parties which left the "Alert," that is to say, would there have been fewer cases than if the one ounce had been retained until they departed?—I should certainly say so.

5459. We have it also in evidence that in the "Discovery" the rate was maintained at one ounce, without any increase as in the case of the "Alert," and that the proportion of cases in the "Discovery" was, to a very marked and striking extent, less than in the "Alert" during the spring expeditions; does that quite harmonise with your theory?—No, not when taken separately.

5460. Other conditions being very much the same, in the case of the ship in which the ration of lime juice was doubled, it was accompanied with a very much larger proportion of cases of scurvy than in the case of the ship where the ration had not been doubled?—As I say, taking these circumstances separately, and in that form, no doubt it does not harmonise.

5461. But at any rate, you think there can be little doubt that whatever was the special condition on board these ships during the winter, there must have been some condition to account for the somewhat unusually rapid and obvious production of scurvy in the spring, when the lime juice was stopped?—There must.

5462. The long confinement and other conditions I think we have already discussed?—Yes.

5463. And the vitiated atmosphere, I suppose you do not think has a more obvious effect in the production of scurvy than long confinement, do you, granting that there was a vitiated atmosphere?—Granting that there was a vitiated atmosphere, I should see in that a probable cause of impaired power of assimilation of food, which need not necessarily result in scurvy, but which, if it impaired the power of assimilating this particular element of food with which we are concerned, would influence the production of scurvy.

5464. And I think you have already said, that although all the conditions to which we have referred as existing on board the ship, and which might reduce the standard of health, did do so, no obvious effect need necessarily have been produced upon the men?—Yes.

5465. In fact, looking specially at the conditions which we know existed on board these ships, the confinement and absence of light, their condition might, on a superficial view, rather have improved than otherwise, by an increase of weight and fat I mean?—Yes.

5466. You have looked at the dietaries of the ships, have you not?—Yes.

5467. Have you any observations which you would wish to offer to the Committee with reference to them?—I observe, as was given in evidence by the medical officer of the "Alert," that the quantity of preserved meat was increased from three-quarters of a pound to a pound. I may say, in

reference to preserved vegetables, I presume that those include potatoes, but not potatoes and molasses: the compressed vegetables were, I suppose, a French preparation. We used them in the Crimea a good deal, and I came to the conclusion that they were useful, but certainly not dependable for preventing scurvy, and not very palatable.

5468. But you do not think that they can supply the antiscorbutic power of an equivalent quantity of fresh vegetables?—No, and I cannot help thinking it doubtful how far vegetables preserved in tins retain their power, but I confess I cannot speak positively about that. I have an impression that the preservation of what we ordinarily call vegetables decreases their power of preventing scurvy.

5469. Of course it is a fact that the juices of vegetables are extremely prone to decomposition?—Extremely so.

5470. And probably a depreciation of the antiscorbutic properties occurs in direct ratio with this decomposition?—I think so.

5471. With reference to preserved meat, have you any remarks to offer as to it affording nutriment or as to its antiscorbutic property, if it have any?—I think that preserved meat, weight for weight, is not so nutritious as fresh meat. I recollect that in the Crimea, when in camp, I had personal experience of that. We lived for the most part upon salt provisions and preserved meats, but the intense relish with which fresh meat was eaten by us, whenever we could get it, seemed to point to something inadequate in the preserved meat, although we had no lack of quantity of that. I know that amongst the labouring classes preserved meats are often not used, because they are described as wanting in economy. The men say that they require to eat a very much larger quantity of them than they would of fresh meat, therefore it struck me that the quantity of preserved meat in this dietary scale, three-fourths of a pound, was insufficient for hardy men; and then I find that it was increased afterwards. I think we must look upon an ounce of lime juice as being the principal antiscorbutic element in the scale of victualling. I do not know the preserved vegetables. There were four ounces of preserved vegetables, and of compressed vegetables one ounce occasionally. I do not know about the preserved vegetables, but I have had experience of compressed vegetables, and I do not think that they are at all to be relied upon.

5472. As a scale of victualling for sustaining life in the conditions which you know existed, do you think it is adequate, with the exception that you refer to?—With the exception of the lime juice, which I think is inadequate in quantity, but with the additional amount of preserved meat spoken of, I should say that it was a fairly good dietary.

5473. Still, if it be the case that some advantage was gained by the use of a larger quantity of preserved fruits, such as jams, and also milk and other extras, might it not be an easy matter, as well as a great advantage, to add these to the ordinary rations?—Most certainly.

5474. I would refer especially to the condensed and desiccated milk. What is your opinion of them?—I have a very strong opinion of the value of them.

5475. Does your remark apply to both?—Yes, to both.

5476. And possibly to eggs if they could be carried, as they certainly can be, for a long period?—Yes, I think so.

5477. Taking into account that probably two eggs are equivalent to about a quarter of a pound of fresh meat?—Yes; I hardly think that sufficient stress has often been laid upon the antiscorbutic qualities of milk. We must remember that infants subsist upon it very often for a year, or sometimes a year and a half of their lives, and it happened to me myself on one occasion to have

an opportunity of testing its value in an adult. I had a patient who had a disease of the stomach which prevented his taking any food but starchy food and milk, and to my knowledge and under my observation, he subsisted for eight months upon Oswego in boiled milk without the least trace of any scurvy appearing in him. Now we have reason to believe that the Swiss condensed milk contains essentially the properties of fresh milk, because every day experiments are being made in that direction by rearing young infants upon Swiss milk, and I have seen young infants do well upon Swiss milk and nothing else. It is a well known fact that children are sometimes brought up on it.

5478. I am glad you have alluded to that, it seems to be of very great importance?—Very great importance. I think it is unfortunate that scurvy is very often spoken of as a disease simply, without reference to the fact that it is a condition *sui generis*. The word "outbreak" is used, and "predisposing causes," and "remote causes," and "exciting causes" one hears of, and the idea seems to have got abroad that lemon juice or lime juice is a kind of specific, whereas I think we ought never to forget that we are talking of a state of starvation; we are not concerned with a specific disease like small-pox, but a state of starvation of a particular kind, and we have to consider other things besides lime juice. Lime juice, on account of convenience of certain kinds, is commonly used for supplying this element; but we are not bound to lime juice. There is no doubt, I suppose, that if we could take potatoes on board ship, and keep them in the state in which we should use them on land, we should never hear anything of scurvy at all. It is the fact that we cannot take potatoes, that they germinate and spoil, that induces us to go to lime juice; but I think it is very disastrous that an idea should get abroad that lime juice is a specific of which it is only necessary to take an ounce a day in order to prevent scurvy for however long a period.

5479. Lime juice being only valuable in the absence of certain articles of diet?—Yes, and inferior to them in this respect, that it is not a natural food; man does not instinctively drink lime juice. I speak from my own experience of that. I took lime juice in the Crimea, and, therefore, I know about it, and it was rather a task to have to take one's daily allowance of lime juice. Had there been an adequate amount of potatoes I should not have taken it at all; I certainly should have taken potatoes or vegetables rather than lime juice, and on that account I think that it is inferior to fresh vegetable food; but the difficulty is that you cannot get perfectly fresh vegetable food on all occasions.

5480. You alluded to potatoes preserved in molasses. Have you had any experience of such potatoes?—No, I have not had any personal experience.

5481. Now, turning to the sledge party dietary, what is your general opinion respecting it?—It struck me that there was a deficiency of the starchy element of food in the sledge party allowance—14 ounces of biscuit.

5482. A deficiency in the starchy, and, therefore, an excess in the nitrogenous element?—Yes; pemmican, I suppose, is a highly concentrated nourishment (*a specimen of pemmican was shown to the witness*). It is very good; it is rather like German sausage in taste.

5483. It is of importance, however, that the farinaceous articles in the dietary should be maintained at a high rate, is it not, on account, among other conditions, of the coldness of the climate?—Yes.

5484. Although their place may, to a great extent, be occupied with fatty substances?—Yes, to a great extent. The item, two ounces of potato, is evidently exceedingly inadequate.

5485. You are aware that in these rations no lime

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juice was included?—The absence of lime juice was of most serious importance.

5486. There being no vegetable food, properly so called, excepting preserved potatoes?—Yes.

5487. Respecting the quantity of which you have already expressed an opinion?—Yes, and the onion and curry powder are only in the form of a condiment apparently. I should say that onions are antiscorbutics, and I believe they can be carried with fair ease without change.

5488. (*Dr. Donnet.*) The information you have afforded in your evidence regarding the origin of scurvy, as arising from the absence of something that is contained in fresh vegetable food, is strong, notwithstanding which I would like to ask a few questions upon this point. Were a man with scurvy to present himself to your observation, would you *a priori* state that fresh vegetable nutriment had been for some definite period partially or completely withheld from him?—I should.

5489. Would you farther state that scurvy will always occur under these circumstances?—The words "definite period" may be the subject of misconception, because I am unable to speak about the time at which scurvy will appear, and, therefore, I cannot speak of a definite period. Using the term "for some period," I should reply in the affirmative to your last question.

5490. Will scurvy occur among the men who have been subjected to an imperfect diet, inadequate for the proper maintenance of perfect nutrition, but abundantly supplied with fresh and wholesome vegetable food?—No, it will not.

5491. I would like to have your opinion upon the use of salted meats upon men under certain conditions, and upon the use of these meats as predisposing towards the production of scurvy?—I think that the influence of salt meat may be described as a negative influence. I mean that salt meat is less nutritious than fresh meat, and *ipso facto*, weight for weight, it would be less effective in supplying the repair of the body, in acting as food; but I do not think that it has any positive and direct influence in the production of scurvy.

5492. Then you think that a diet of salt meat simply represents a less degree of starvation than a total absence of animal food; in fact, that starvation intensifies scurvy, as you have said before?—I think that perhaps one might put it in another way, namely, in this way, that weight for weight, salt meat is less nourishing than fresh meat. Of course, if you put it as being a less degree of starvation than no meat at all, that is one way of putting it.

5493. You consider, from what I understand, that meat salted loses a great deal of its nutritious element?—I think it loses something; I am not prepared to say how much, but it loses some of its nutritious qualities by salting. I may say, perhaps, upon that, that it is notorious that formerly it was supposed that the salting of meat had a direct influence in making meat actively productive of scurvy. I think that all experience has shown that that is distinctly not the case; that as regards any active influence salt meat is no more likely to cause scurvy than fresh meat, and that the way in which it acts at all is by its being less nutritious, weight for weight, than fresh meat, and likely therefore to cause scurvy to appear sooner under its use than under that of fresh meat.

5494. Then, were men abundantly supplied with vegetable food, scurvy would not occur under a diet of salt meat?—No, it would not.

5495. I believe you have described scurvy as a peculiar state of malnutrition supervening gradually upon a continued use of a dietary deficient in fresh vegetable material, and tending to death after a longer or shorter interval if the circumstances under which it arose remain unaltered. Under these circumstances, is it your opinion that men subjected, as the men in the sledge parties were, would at some period

sooner or later fall victims to scurvy?—Yes; I think such a result might have been confidently predicted. I should like to add, that in my experience in Asia Minor frost-bite occurred extensively amongst the troops in the winter campaign in the Caucasus, although the temperature was not excessively low. It occurred particularly in men who were scorbutic. I have seen feet and hands separate from the body in the beds, actually fall off, from frost-bite.

5496. Did the scorbutic condition assist in the production of frost-bite?—I think it did.

5497. Under what conditions did the cases of frost-bite appear?—The men had been starved generally, and specially in relation to antiscorbutics, and had been exposed to cold and much wet. The lower extremities suffered more frequently than the upper.

5498. As your experience of scurvy has been great, would you oblige the Committee by enumerating the most prominent symptoms that you perceived amongst these cases?—A peculiar kind of dirty pallor is a characteristic and early symptom of scurvy, debility, and apathy of manner; a condition not so much of anxiety as to the state of health as of indisposition to take any trouble regarding it. The patient lounges where formerly he has displayed energy in his occupation; he does not care to speak unless addressed. In reply to inquiries, he usually complains of flying pains about the limbs and back, which he generally refers to rheumatism. The change of aspect, where several individuals are exposed to the same circumstances, will be noticed by them of each other, whilst the observer is unconscious that he too is presenting the same appearance. Up to a certain period the appetite remains good, and digestion continues tolerably perfect; usually, however, there is some constipation. There is no fever. Sleep is obtained readily enough. It is sometimes described as accompanied by dreams, in which the luxuries of fruits and vegetables are vividly pictured. Gradually petechiæ are observed, especially about the legs and thighs. They are small, of a reddish brown colour, fading away at the edges, and are especially apt to occur at the points where hairs perforate the skin. They are usually not elevated above the surface. Besides these there may be larger maculæ apparently formed by the coalescence of several petechiæ of irregular outline, and particularly common about the lowest part of the legs and on the feet. As the disease advances, still larger markings will be noticed, so much resembling bruises as often to be mistaken for the results of violence. These are apt to fix upon weak portions of the frame for their situation, parts where there has been a blow, strain, or other injury some time previously. Accompanying these external signs, there is breathlessness, for which the ear applied to the chest fails to discover any adequate cause. The expression of the countenance is dejected, or it wears an aspect of indifference. The lips are pale. By degrees the face assumes a bloated appearance. In some cases, however, about this period, the eye and its surroundings are the only parts exhibiting signs of scurvy. The appearance presented is then very remarkable; the integument around one or both orbits is puffed up into a bruise-coloured swelling. The conjunctiva covering the sclerotic is tumid, and of a brilliant red colour throughout. There is nothing inflammatory about this condition; it resembles very violent ophthalmia in the colour presented, but there is no pain or discharge. I have seen many cases in which this appearance, together with pallor of the complexion and listlessness, constituted the only evidences of scurvy, and they have generally been of the most serious character, often terminating fatally. The gums so generally present a remarkable alteration in scurvy, that their condition has been often described by writers as a perfect test of its presence or absence. My own experience does not correspond with this. All the other phenomena may be present, and yet the gums continue in an unaltered condition, except that they are pale.

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But usually, early in the disease the gums, first of all pale and contracted, begin to show a swelling at their free margins. This gradually increases, so that the teeth are encroached upon, and eventually, in some cases, almost disappear from sight in the huge fleshy masses which encompass them. The swollen gums are then spongy, of a dark red or livid hue, not sensitive to the touch, and disposed to bleed, sometimes slightly, at others profusely, when irritated. Under these circumstances, the teeth become loosened in their sockets, and often fall out. There is a sickening fetid odour from the breath. This is only observed as an accompaniment of the swollen state of the gums, and is evidently due to the sloughing which usually occurs in them. So severe is the affection of the gums in many cases, that fleshy masses like huge granulations are often seen to protrude between the lips. Chewing is completely impossible, and there is some difficulty even in taking fluid nourishment. It is impossible to describe the fearful appearance presented by the sufferer under these circumstances. His skin harsh, dry, dirty-looking, and discoloured with bruise marks, bloated and puffed up in parts by swellings, his whole manner apathetic and helpless, the condition appears to a novice more irremediable than is seen in almost any other disorder. And yet it is remarkable that these cases, where the external manifestations of the disease are so strongly marked, are frequently just those which yield most rapidly and surely to treatment. The change wrought in a few hours by the administration of lemon juice or vegetables, coupled with general care, is the most extraordinary thing in therapeutics, and of itself furnishes a powerful argument in favour of the cause of scurvy existing in the absence of such food. Besides the petechiæ and other larger ecchymoses under the skin, which I have described, a most frequent and highly characteristic symptom appears in the occurrence of swellings in the flexures of the joints. A favourite seat of this condition is the ham. The web between the insertions of the flexor muscles is filled up more or less completely by a mass which is hard, but not so unyielding as to be incapable of pitting on pressure. It requires, however, more force to produce this effect than in œdematous swelling, and the impression is retained for a longer period. As this swelling increases, the limb is gradually more and more rigidly flexed, doubtless because extension, by stretching the skin over the tumour, is attended with great pain. If the effusion occurs, as it most commonly does, in the lower extremities, the patient is unable to walk. A similar swelling is sometimes noticed at the bend of the elbow, and still more frequently beneath the muscles of the jaw. In the latter position the movements of mastication are very painful. Another common seat of such effusion is under the muscles in front of the tibia, or between the periosteum and that bone where it is subcutaneous. The skin covering such swellings may retain its colour, or present an ecchymosed aspect, according as the subcutaneous connective tissue is invaded or not by the effusion. The breathlessness which I have mentioned as an early symptom in scurvy becomes more confirmed as the disease progresses. On auscultation we find the respiratory murmur louder than natural, but otherwise unaffected. It is very frequently accompanied by occasional faintings, especially when the body is made to quit the horizontal posture. These attacks of syncope are highly perilous. It has happened to me on more than one occasion to witness death from this cause. The patient, previously recumbent, has suddenly sat up in bed to receive my visit, and speedily fallen back in a fainting fit, from which he could not be restored. At Trebizond, notwithstanding that great care was used in the transport of sick from the ships to the hospital, many died whilst being carried up. The danger from fainting was well known in the "Dreadnought" hospital-ship; and Dr. Harry Leach, formerly the resident medical

officer, informs me that no scorbutic patient who was severely affected was allowed to walk up the steps, but was carefully hoisted up the ship's side in a recumbent position. There is an affection of the chest in scurvy which, especially when the disease occurs during the prevalence of cold and damp, is very apt to be mistaken for pneumonia. Faint rigors, followed by a certain amount of feverishness, and accompanied by lancinating pain in one or both sides, usher in this condition. The pain is felt only in coughing, and a very viscid mucus is expectorated. The dyspnoea increases, and a constriction, as though from a cord bound tightly round the chest, is described. Although it occasionally happens that these pulmonary symptoms are dependent upon true inflammation they are much more commonly associated with effusion of sanguineous fluid into the cavity of the pleura, or into the substance of the lung itself, these structures sharing with every other organ that tendency to effusion which is the dominant feature of scurvy. When the lung is thus invaded the expectoration after a short time becomes dark and sanious, with all the horrible fetor which is ordinarily associated with gangrene of the lung, but which is here dependent upon decomposition of the bloody fluid poured into the lung substance. There are now cold sweats, increasing dyspnoea, and anxiety, a pulse small and frequent, softer than in inflammatory pneumonia, and death takes place. In other cases there is no pain or cough, but the breathing rapidly becomes short and laborious, and death occurs suddenly. Auscultatory signs of mischief in the lungs are usually wanting, but now and then there is localized dulness on percussion, with bronchial breathing, or mucous râles are heard; sometimes also gurgling sounds at certain parts of the chest. The symptoms of gangrene of the lung, when it occurs, are indistinguishable from those arising from effusion of fluid which becomes decomposed. The mere occurrence of very fetid and dark sanguinolent sputa is not necessarily an indication of either condition, as its source may exist in the sloughing and bleeding gums. But constant and increasing oppression of the breath, frequent syncope, and great anxiety point unmistakably to pulmonary mischief; and cases in which these occur are amongst the most hopeless which are ever encountered. Dulness on percussion may sometimes be noted under circumstances when it probably may be correctly referred to sanguineous effusions into the muscles of the chest, and unconnected with lung mischief. The diaphragm also is sometimes invaded by effusion, and great difficulty of respiration may be thus produced. It is not usually practicable to distinguish the dyspnoea arising from this condition from that caused by lesion of the pulmonary substance, but its significance is not so serious, and it will generally subside with rapidity as the scorbutic state is remedied by dietetic treatment. As regards the digestive system, the tongue is usually clean and moist. The colour is sometimes red, at others pale, with a violet tinge. It is often large and flabby, showing the teeth marks at the edges. In the early stages of the disease there is tendency to constipation. Later there is usually more or less of painless diarrhoea, often sanguineous in appearance, but unaccompanied by the other symptoms characteristic of dysentery. Scurvy, when it occurs in camps, is so frequently, if not constantly, complicated with the dysenteric diarrhoea which commonly prevails under those conditions, that disturbances of the digestive system are amongst the most frequent concomitants of the disorder. It does not appear, however, that without such an exciting cause, dysentery is to be considered a symptom of the disease. The dejections usually consist of undigested food, with a quantity of colourless fluid, somewhat resembling the evacuations of cholera; or they may be accompanied by a considerable flow of dark blood. The slimy, bright, blood-stained, and offensive fæces of dysentery are wanting, unless that disease be present

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as an accidental complication. A fatal result is not unfrequently due to this exhaustive diarrhoea, the patient becoming worn out by the frequent discharges. The intellect of patients suffering from scurvy is usually remarkably free from impairment. The listlessness, however, to which I have referred is constantly present, and is sometimes accompanied by great depression of spirits. As a rule, there is complete coherence of ideas, but I have seen cases occasionally in which symptoms of excitement of a maniacal character were present. In confirmed scurvy the slightest pressure suffices to open the skin and to give rise to an ulcer, whose edges are hard, thick, and shining, and the surface fungoid and bleeding. Its tendency is to increase rapidly in size, and to invade the neighbouring structures. An intolerably offensive odour is emitted from it. Ulcers such as these will often eat their way into the soft tissues with great rapidity, exposing and invading large vascular trunks, from which dangerous hæmorrhage may occur. Sometimes the disorganization of the flesh is sufficiently complete to expose the bones and produce caries. The lips and nostrils are occasionally the seat of this ulceration, and the patient then presents a ghastly appearance, much like that of an aggravated case of lupus. The exhaustion attendant upon these spreading ulcers is often fatal. Wounds, and even slight scratches, become invaded by this process. Its influence in cases of frost-bite is most disastrous. Night blindness is frequently observed in scurvy. In some cases recorded by Dr. Bryson, it was the first symptom of the disease noticed. The patients can distinguish objects well enough during daylight, and even at night can read a book held close to a candle, but the moment they pass from the influence of the light they become absolutely blind, and require to be led about. Mr. G. Lawson informs me that several such cases have fallen under his notice at the Moorfields Hospital, but in none has the ophthalmoscope revealed any signs of mischief. The pupils he finds sometimes dilated and sluggish, in other cases natural. The condition rapidly subsides under an antiscorbutic regimen. Mr. Soelberg Wells, too, tells me that he has met with the symptom in cases of great depression of the nervous system, after severe illnesses, and in badly fed and cachectic subjects. It sometimes occurs in prisons.

5499. Do the pictures (*handing two pictures to the witness*) which I show you portray faithfully the patches and effusions which you have described to us?—Yes; I notice especially what I have described as the dirty pallor, and which is very well indicated there, the peculiar colour of the skin. The pictures are both very characteristic.

5500. You spoke of men in cases of scurvy dreaming of vegetables and fruit. I do not know whether you are aware that the dreams of a similar nature have visited the sleep of the arctic travellers who have been pressed by hunger?—No, I have not heard that.

5501. Would you consider these phenomena as a mental expression, urging the dreamer to the choice of a food best suited to his condition?—Yes, I should certainly.

5502. Having given so full a description of the symptoms of scurvy, would you kindly add a description of the morbid appearances after death?—I can only give you the morbid appearances at second-hand. All my patients were Mahomedans, and no *post mortem* examinations were permitted; but as the result of my study of the morbid anatomy, as described by those who have had the opportunity of examination, I can supply you with some information. The body of a patient who has died of scurvy is generally emaciated, but this is by no means always the case. Where the diet has been absolutely deficient, or of such a nature that its mastication was almost impossible from the condition of the gums, there is much wasting. Scurvy, however,

may occur when there has been not only no lack of food, but the nutriment has been of a kind easily taken by the patient, although from its quality it has not been able to prevent the disease. Under such circumstances the general bulk and weight of the body are fairly preserved, whilst the tissues are found to present the appearances characteristic of the disorder. Externally, the body presents the same general aspect as was observed during life. Decomposition is more than ordinarily rapid. The extremities are usually rigid. Blood is sometimes observed to flow from the mucous passages. Blood, or fibrinous effusion, more or less strongly blood-coloured, is found extravasated under the skin into the subcutaneous areolar tissue, and into the aponeurotic sheaths of the muscles, sometimes bruising and breaking the muscular fibres. The lower extremities, and especially the hams, are generally the most severely affected, but the same condition may be found in the arms, particularly about the bend of the elbow and under the pterygoid muscles of the jaw. These effusions, when they take place under the periosteum, sometimes lead to death of the bone beneath, and this has not unfrequently occurred in the jaws. Simple serous effusions besides, depending apparently on the obstructed circulation, occur, especially about the feet and ankles, so as to give a peculiarly clumsy appearance to the lower extremities. The condition of the brain varies considerably. It is often free from any appearance of lesion. Sometimes there is effusion of serum under the arachnoid and into the ventricles, whilst the vessels on the brain surface are empty, and the general aspect of its substance is pale. In other cases the cerebral vessels are gorged with very dark fluid blood, or coagula, and there may be ecchymoses upon the surface of the brain, and sanguineous effusion into its substance. Serous fluid, sometimes in large quantities, is frequently found in the pleural cavities. The lungs may be pale, shrunk, and bloodless in appearance, or gorged with serous fluid, and sometimes with very dark blood. When grave symptoms of mischief in the chest have presented themselves during life, stains or violet marblings, like to those on the skin, have been found upon the surface of the lungs after death. On cutting into these they are found to be of varying depth, but usually superficial. Internally, the vesicles and small bronchi contain a mucosanguinolent product; there is, besides, slight or severe bloody infiltration into the cellular interstices of the pulmonary vesicles, occupying especially the bases of the lungs, and characterised by a red-winey tinge, with impregnation of black blood. In certain cases the lung offers in some points all the characters of the most complete engorgement, loss of elasticity, crepitation and permeability, increase of volume and of weight. These characters, however, are never carried to the extent seen in ordinary pneumonia. It is principally at the diaphragmatic aspect inferiorly and posteriorly that this engorgement is seen, physical laws tending materially to the choice of this site. Little deposits of blood, not coagulated, are found in different parts of the lungs. These are of variable volume, and constitute, in fact, a species of ecchymotic collections, which compress and obliterate, little by little, the pulmonary vesicles. They form sometimes largish, fluctuating tumours, composed of liquid blood without clots, contained in cavities of irregular form, which are not lined by any membrane. The sudden rupture of such tumours causes considerable hæmoptysis. Occasionally the lung will be found gangrenous; it is then characterised by the usual greenish-grey colour of its structure, mixed with darkened fragments, and imbued with air-bubbles and an ichorous bloody liquid, breaking up under slight pressure, and emitting a most offensive odour. An equal uncertainty attends the condition in which the heart may be found. It is sometimes pale and flaccid, with the cavities quite empty. In

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other cases it is filled with black liquid blood, and its cavities are dilated. It sometimes contains fibrinous clots which are manifestly of *ante-mortem* formation. Occasionally its lining membrane, as also that of the aorta and pulmonary artery, is stained with a reddish tinge. Black fluid blood is sometimes found in the pericardium. The muscular substance of the heart may be ecchymosed. The muscular and mucous coats of the stomach and intestines are invaded usually by sanguineous effusions, and the deposits present all that variety of colour which is characteristic of bruises in their various stages, varying from a pink to a blackish-green tinge. The intestines themselves may contain fluid blood. Dr. Ritchie describes an enlarged condition of the solitary glands in the lower part of the ileum. The mucous surface of the intestine is sometimes abraded with minute and superficial ulceration, or it may present detached black ulcers of considerable size. There is a tendency to increase of severity in these towards the lower extremity of the bowel. The liver and spleen are often, but by no means always enlarged, gorged with dark blood, and their structure softened and friable. With all the variety which may present itself in the *post mortem* appearances, there is one appearance which is constant in all cases of death from scurvy. In some part or other, sanguineous effusion into the tissues will be discovered. Considering the delicate structure of the brain, it is remarkable that lesions of this organ occur by no means so commonly as in other and less vital parts of the economy. As regards the nature of the effusions which play so important a part in the fatal results of scurvy, minute observations would seem to show that they are essentially fibrinous in character, more or less coloured by blood corpuscles. They are sometimes gelatinous in consistence, marked with streaks of a pale yellow colour, somewhat resembling the fibrinous clots so often seen in the heart. They occasionally exhibit a higher degree of organisation. Deposits of this kind occur in the form of layers of from a quarter of a line to a line in thickness, composed apparently of fibrine of a bright yellowish-red colour, firm and elastic, affording no fluid on pressure; they are in fact false membranes, and are quite distinct from the surrounding muscles to which they adhere. This kind of deposit has been termed "scorbutic formation." The stiffness of the joints, and especially of the knees, appears to be caused by the firm consistence of these effusions. Upon injection, capillary vessels have been discovered, which in their character and mode of distribution are similar to those met with in other recently organised adventitious tissues. It seems most probable that the hypertrophy of the gums proceeds from the deposit of a plastic material. They are firm, and bleed when wounded. The rapid absorption which they undergo upon treatment is inconsistent with the supposition that they are distended with blood, but is explicable upon the view of the fibrinous character of the enlargement.

5503. If you would glance your eye over the sledge dietary list, which I now show you (*handing one to the witness*), would you say that men living on such a diet would remain exempt from scurvy for any length of time?—I should say that it would be impossible for them to remain exempt from scurvy for any length of time on such a dietary as this.

5504. Have you thought what the element in lime juice is that gives it its antiscorbutic properties?—By exclusion I think that we may conclude that this element lies in citrate or malate of potash, probably coupled also with citric acid and malic acid.

5505. Do you think that it requires a combination of these elements to give it its antiscorbutic qualities?—I think it requires the presence of those substances to constitute its antiscorbutic efficiency.

5506. Have you any opinion of citric acid as an

antiscorbutic?—I have no personal experience of its use; but my study of recorded experiments induces me to believe that it is far inferior to lime juice in efficacy, if it possesses any at all.

5507. (*Admiral Inglefield.*) The great experience which you had of scurvy during the Crimean War must have afforded you opportunities of judging whether one class of man is more likely to be attacked than another; I allude to a fair or a dark man?—The Turkish troops, I think, were almost uniformly dark men; the Turks are a dark race.

5508. Then you had no opportunity of comparing fair and dark men?—I had no personal experience amongst the scorbutic patients in the English and French army, so that I had not the necessary opportunity.

5509. Have you any opinion as to what the age of men should be who might be employed on future arctic expeditions; in other words, at what age men's constitutions are so formed that they are less susceptible to scurvy than at any other age?—No, I really can give no information on that point.

5510. Have you formed any opinion as to whether raw meat, which contains certain juices which may be dissolved or evaporated in the course of cooking, may not be beneficial to administer to a patient having scurvy in preference to cooked meat?—Yes, I think that is very probable, but I have no personal experience on that point.

5511. Have you read the account of the extraordinary drift of nineteen souls over a floe of ice for six months from Littleton Island in latitude $78^{\circ}48'$ to latitude about 53° north, having nothing in the shape of diet excepting seals, bears, and walrus, and the only preserved food was hard biscuit and pemmican?—I have never seen that account.

5512. They never had the slightest attack of scurvy during the whole of that time, and amongst them were two women and three or four children, one child at the breast, and yet there was no record in the whole of that account of the slightest scorbutic symptom?—I cannot explain that.

5513. You have nothing to which you could attribute this exemption?—Nothing. I should like, before even attempting to explain it, to be satisfied that the account given is a correct one.

5514. It is from one of the survivors, Captain Tyson, and I have gone carefully through it, and there is not a scorbutic symptom mentioned during the whole time; and they were drifting during the winter months. The practical question is as to the utility of lime juice on sledge journeys. The reason you will have found given in these papers why it was not carried on the sledges was on account of the necessity to take a certain portion of fuel for the purpose of melting the water to mix with it. We have had evidence given us that it is possible to concentrate lime juice. Can you give the Committee any information as to whether such concentration would interfere with its beneficial effects?—No, I think that could only be arrived at by experiment, and I have never gone into that.

5515. You have no opinion to give upon the subject?—No, except that, I should think, judging from what we see done in the case of milk, that it might be feasible to use concentrated lime juice.

5516. Would you attribute the predisposition to scurvy to a want of a proper amount of sleeping space for the men; I mean cubic space in their sleeping apartment?—As I have said before, I could only say that indirectly by its influence upon health, and probably, therefore, upon the power of assimilating the elements of food, it might have an effect in the production of scurvy.

5517. One ounce of lime juice is the proportion given as a ration on board ship ordinarily, but in the merchant service we have evidence that two ounces are sometimes given. Would you lean in favour of the larger proportion?—Distinctly.

5518. That, in fact, it should be administered

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throughout the winter in that proportion?—I certainly think so, or even in a larger proportion. I think the proportion should be adjusted in accordance with the observations of the medical officer as to the condition of the men, and I do not think that we know yet what amount of lime juice may be necessary for the prevention of scurvy during long periods of confinement and under such exceptional circumstances as prevailed in the arctic expedition.

5519. What amount of lime juice might a man take per diem without receiving any deleterious effects?—I do not know; I should think a very large amount.

5520. Three or four ounces?—I should think that a man might take more like a pint or so without being damaged by it. I do not see what there is in it to do him harm. It is a matter that I really have never thought about, but on reflection I think probably a pint might produce diarrhoea.

5521. Then I should like to hear definitely if you consider that it should be a *sine qua non* that lime juice is carried upon all sledging journeys, men having been treated in the manner which is described in these Arctic voyages during the winter months as they are necessarily treated, with confinement, darkness, and cold?—I distinctly think so.

5522. And what should, then, be the ration, do you think, putting quite aside the question of difficulty of portage?—I think that that would have to depend upon the medical officer's observation of the effects of certain quantities antecedent to the departure of the sledge parties, and that he would have to remember that the men were going to be subjected to a very much increased amount of muscular exertion, and that therefore, in all probability, the relative quantity of the essential element of food contained in lime juice would have to be increased *pari passu* with the quantity of food generally, in order to supply and complement the additional demands made upon the economy by the intense muscular exertion to which the men were going to be subjected.

5523. Then, in other words, if one ounce per diem was considered a fair ration during the winter months, when the men were living a comparatively idle life, a larger amount would be the proper ration for them when travelling, when exposed to great exertion and muscular action?—I am strongly of opinion that it should be so.

5524. Doubtless you consider that the mind and the depression of the mind has a great deal to do with developing the symptoms?—No, I do not. I think that that condition of mind is one of the scorbutic symptoms.

5525. Do you consider that preserved potatoes are deprived, in the process of preservation, of a great portion or any portion of that nutriment which is so essential, and to which you have alluded so strongly?—I am unable to say. That is a point on which I should very much like to have information myself.

The witness withdrew.

HARRY LEACH, Esq., M.R.C.P.L., examined.

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5536. (*The Chairman.*) You are a Member of the Royal College of Physicians, a Member of the Royal College of Surgeons, Medical Officer of Health for the Port of London, and Medical Referee to the Board of Trade?—Yes.

5537. You lately were Senior Medical Officer of the "Dreadnought," Seamen's Hospital, and are one of the Visiting Physicians at the Seamen's Hospital, Greenwich?—Yes.

5538. (*Dr. Fraser.*) In your connection with the "Dreadnought" Hospital, you have had much opportunity of seeing scurvy, have you not?—Yes, for about fifteen years.

5539. And you, no doubt, inquired into the origin

5526. Does anything else occur to you to suggest upon the subject of this outbreak of scurvy in the recent expedition?—I should suggest that the American plan of carrying raw potatoes cut in slices, preserved in molasses, is from all experience very useful, and I think might be added with advantage to our own existing dietary.

5527. And that it is preferable to preserved potato?—Yes, I think that experience is positive upon that point, that raw potato, weight for weight, is a more potent antiscorbutic than cooked potato, and probably than potato preserved like Edwards's, in the preparation of which heat has been used.

5528. (*The Chairman.*) I observed you stated that you were much struck by the very speedy effect of lime juice as a curative. Would you further consider that as a strong reason for supposing that its efficacy as a preventive is very great?—I should.

5529. (*Dr. Fraser.*) The preparation you recommend of potatoes in molasses, I suppose, ought to be eaten as a salad in the raw state, and not cooked?—Yes.

5530. Do you know of any case in which lime juice has been swallowed in the quantity to which you have referred, a pint or so?—No, I do not.

5531. It is not, however, a decidedly toxic substance, though it is capable of producing toxic effects?—Yes.

5532. Injurious symptoms, however, have occurred in men with considerably smaller doses than the very huge one to which you have referred; you, perhaps, do not know that?—I do not know that.

5533. And although one single large dose may not produce any marked effect, what is your opinion of the prolonged use of a large dose for some months; for instance, would it at all interfere with the digestion, taking into account the free acid present in the lime juice?—I think that is possible.

5534. (*Dr. Donnet.*) Though climatic influences, heat and cold, hard work, and the influence of the absence of light combined, are not the exciting cause of scurvy, would you consider them as predisposing causes?—For myself, I hardly like to use the word "predisposing" in reference to a condition like scurvy, because it is, as I say, a question of starvation.

5535. Are those influences necessary antecedents to scurvy?—No, certainly not; I would put it in this way: supposing I go without food altogether for three days, I get into a state of inanition, and prostration. I do not see how one can use the word "predisposing" in reference to that condition; it is a question of starvation, because there is the absence of food. So in scurvy, the cause is the absence or inadequate quantity of certain food, which is starvation. I think that the subject sometimes has been confused by treating the question of scurvy much in the same way as we deal with the question of diseases which are dependent, for one factor, upon the introduction of *materies morbi* into the system from without.

of the cases that came under your observation?—Yes, I have done so carefully.

5540. You have also been employed, I understand, by the Board of Trade to make inquiries into what maybe termed outbreaks of scurvy, on many occasions?—Yes, during the last eight or nine years.

5541. Could you favour the Committee with the general result of these various inquiries?—I think I may declare shortly that the general result of the inquiries that I have instituted has been this, that since the Merchant Shipping Act of 1867 came into operation, commonly called the Duke of Richmond's Act, by which the quality of all lime juice was assured by legislation, scurvy has decreased 70

per cent in the mercantile marine. I am speaking of my own statistics that I have gleaned in connection with the "Dreadnought" Hospital, and hand in figures in reference thereto, and also the experience that I have acquired in connection with inquiries instituted by the Board of Trade.

5542. Will you shortly favour us with the general result that you arrived at in inquiring into the causation of the cases that came under your investigation?—Speaking briefly, I class the causation first to the want of antiscorbutics, such as lime juice, or any other class of fresh vegetable food, and the bad quality of animal diet, or insufficient quantity of animal diet.

5543. Do I understand that the bad quality or insufficiency of animal diet may, in the presence of what you regard as a sufficient vegetable diet, be a cause of scurvy, so far as your investigations have gone?—Clearly.

5544. Can you give us a few instances in which that may have occurred?—I give the instance of the "Royal Sovereign," which is one of the cases that occurred within the last year, and which appears in a Parliamentary Paper, headed Merchant Ships, Health of Crews, 117 of that year.

5545. Is it your opinion that this bad animal food, or imperfect supply of animal food, is a direct cause of scurvy?—Yes; I should class it as a cause, as I have reported there.

5546. That opinion is based on a constant experience directly bearing upon that point?—Yes, on an experience of thirty or forty inspections under the Marine Department of the Board of Trade.

5547. All of which pointed to this one cause, bad or insufficient animal food?—No, not at all; but in some instances I should class the quality of food as the cause. I am speaking of all the inspections that I conducted.

5548. I want to have a clear idea on a point which is one of considerable importance. If animal food be supplied of inferior quality, and if good fresh vegetable food be at the same time supplied, you think that scurvy may occur?—I mean that scurvy may occur, if bad animal food with good lime or lemon juice is at the same time supplied.

5549. Then is that on account of the bad quality of the animal food, or on account of the insufficient quantity, do you think?—Either, or both.

5550. Is it, in other words, a case of poisoning by deteriorated food?—I should declare it a case of insufficiency of nutritive properties in consequence of the age of the meat, or in consequence of its imperfect storage, or of pickling, or something that is defective in it that has spoiled its nutritious properties.

5551. If the animal food were in those cases altogether removed, what would you anticipate would have been the result; that is to say, taking it as granted, as we have already done, that there has been a sufficiency of fresh vegetable food, if the animal food which you have supposed to have been the cause of the scurvy in these cases had been altogether taken away, would scurvy have occurred, do you think?—It would, after a prolonged interval.

5552. You of course express that opinion, knowing quite well that there are many people who subsist entirely on vegetable diet, vegetarians?—Yes.

5553. And who, so far as I know, are not particularly subject to scurvy, if at all subject to it?—No.

5554. That being your opinion, can you tell us generally whether, so far as your experience has gone, the cause of scurvy could be referred to inferior quality or deficiency of animal food on the one hand, more frequently or less frequently than to the deficiency of fresh vegetable food on the other hand?—I class this case that we have discussed as exceptional, speaking comparatively. It is not the only one, but it is the most glaring instance, and I pointed out the most glaring instance at the commencement of the questions.

5555. Then it is the case, so far as your experience has gone, and you have had a very large experience, that scurvy has been most frequently produced by the absence of fresh vegetable food?—Yes, clearly.

5556. Previously to this Act which you have referred to, the Act of 1867, was the character of the lime juice often suspicious as supplied to the merchant service?—Yes; it was in consequence of analyses that I and others had made, and finding that it was glaringly defective, and often that there was no lime juice in it, that we strongly urged upon the Board of Trade the necessity of ensuring the quality of the lime juice, and of increasing the quantity of it also.

5557. May I ask you whether it is lime juice or lemon juice which is really used in the merchant service?—I should think, speaking roughly, about one-third of the owners are supplied with lime juice, and two-thirds with lemon juice. I can speak of it as a commercial matter, because I am acquainted with most of the large houses that supply it. Lemon juice is used simply because the market will not allow the West Indian lime juice to come over in sufficient quantity.

5558. Do you think it is an unimportant matter as to whether it be lime juice or lemon juice?—I am inclined to think that lime juice is more antiscorbutic than lemon juice, there is more of the extractive matter in it.

5559. And with reference to the quantity of acid, it is greater, is it not?—The citric acid is sometimes greater and sometimes less; citric acid varies as to the time when the limes and lemons are picked, as you are aware, it very much varies whether they are ripe or unripe.

5560. This lime juice and lemon juice for the merchant service is therefore obtained from various sources?—Yes.

5561. But it is all examined, is it not?—It is all examined under Customs arrangement in bond.

5562. And who is it that makes the examination?—The laboratory officers of the Inland Revenue examine it for the Board of Trade, at Somerset House.

5563. That is a recent arrangement, is it not?—Since the middle or end of 1868. I inaugurated it here and at the outports, but it was discovered to be more economical to put it into the hands of the Inland Revenue, and samples are now sent up there from the outports as well as from London.

5564. Is there any brand or other distinguishing mark placed upon it?—Yes, the Customs' seal is fixed upon it.

5565. Is it lawful to use it otherwise than sealed; must all that is issued be sealed?—It must be issued ostensibly for the use of crews at sea.

5566. But none can be issued, according to law, which has not been certified to be good lime juice or lemon juice?—Just so, and fortified with 10 per cent. of rum, or some other class of spirit.

5567. Is it prepared in that manner for preservation?—Yes.

5568. I understand that some process is sometimes followed of heating the lime juice, and getting rid of a certain quantity of the mucilage; have you heard of that being done?—I think I should have been consulted as to it, and I have not heard that that has been the case.

5569. It is not so, at any rate, in the merchant service?—No, not in the merchant service.

5570. Can you tell us where the limes and lemons come from that are used?—The chief of the limes come from the West Indies. I should think about three-fourths from the Island of Montserrat, which is owned by Messrs. Edmund Sturge & Co., the large citric acid manufacturers, of Birmingham, and the lemons, I ought to say, are procured from the islands of the Mediterranean, chiefly from Sicily.

5571. Can you tell us what is the standard, with reference to either lime or lemon juice?—The Board of Trade standard, which I cannot give now ac-

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curately, but which may be obtained from the Chief of the Inland Revenue Laboratory.

5572. Can you give us any information as to whether in other countries lime juice is used by merchant ships?—In the United States it is utterly scorned. I have been over there, and have discussed it at New York, and they all declare that they do not think anything as to it.

5573. (*Admiral Inglefield.*) Do you mean that it is not used at all in the United States?—Not in the mercantile marine. I have this on the authority of the United States Vice-Consul in London, Mr. Joshua Nunn.

5574. (*Dr. Fraser.*) Are you aware whether they employ any substitute for lime juice in America?—They give them a variety of vegetables, a scale of which I shall be glad to enclose. I have the scales of the chief New York houses, as the Messrs. Grinnells, and others.

5575. You have probably remarked that potatoes with molasses are largely used in American ships?—Yes, rolled in molasses—they roll them over and eat them raw.

5576. Then that, in their opinion, must be a very valuable antiscorbutic?—Yes.

5577. Probably more valuable than lime juice?—Yes, I should think so, but not quite so convenient for stowage.

5578. Are you at all acquainted with the general accommodation which is given to seamen on board merchant ships?—Yes, it is included in our inquiries; I inspect the quarters closely, and I ask about ventilation, and examine the ventilation and the cubic area, &c.

5579. Can you give us a general idea as to what you usually find?—As to the general class of ocean-going accommodation, there is comparatively little to be complained of now.

5580. What do you consider the space which should not be complained of for seamen on board ship—I mean between decks, of course?—As you are aware, the Board of Trade has a minimum scale.

5581. What is the minimum scale?—Seventy-two cubic feet, and twelve superficial feet measured on the deck or floor.

5582. I suppose there is no general system of heating adopted in large ships, is there; it is left very much to choice or caprice?—I think it is utterly absent.

5583. Even in ships trading in the north?—Yes; the only class of ships in which heating is adopted, is some of the coasters, and in the discharge of my duties as Port Medical Officer, I and my inspectors are constantly endeavouring to clear stoves out of forecastles, because it is a nuisance in those small vessels, but with the ocean-going ships it does not exist. There is no stove or any class of heating, either by water or air.

5584. It is not required to any great extent, is it?—I should think not.

5585. I think you had an opportunity, of which you availed yourself, of examining the "Alert" and the "Discovery," previously to their departure?—Yes.

5586. And were you generally satisfied with the accommodation for the crews in both of these ships, or have you any observation to make upon that point?—It struck me that there was a closeness and general want of ventilation, but I have had no experience of Arctic voyages, and I question whether one's opinion can be worth anything on such a point.

5587. You mean to say that the impression which you derived from merely looking at the ships may not be of very much worth, as to the requirements of arctic service?—No; I said to one of the officers, "It seems to me that your crew is extremely closely packed here, especially considering that you are obliged to have closed hatches quite through the winter." That was the gist of the observations that I made upon the matter.

5588. You did not take any trouble to determine what space each man would have?—No; but I am quite clear that it was smaller, I should think, than in other ships of the Royal Navy, from what I have observed.

5589. That would no doubt to some extent be due to the fact of their wishing to retain all the heat that they could?—Yes.

5590. And that their storage accommodation was fully occupied, and that a large space was required for the exigencies of the service in the arctic regions, sledging services and so on?—Yes.

5591. Of course, whatever the accommodation might have been, it was very necessary, was it not, to change the air with a certain amount of frequency?—Yes; and it struck me that there would be a variety of obstacles in consequence of the arrangements made; of course I am speaking generally.

5592. The cold outer air being one of the greatest obstacles to frequent renewal?—Yes.

5593. Do you think that any advantage would have been derived, or would be derived, by heating this cold external air prior to its distribution between decks, so far as the more frequent renewal is concerned?—Clearly, if it were practicable I should think it would be an advantage.

5594. I believe you have had placed before you the papers relating to this recent expedition?—Yes, and I think I have read them all.

5595. You have read them, I dare say, with reference to the outbreak of scurvy?—Chiefly.

5596. Have you arrived at any conclusion which you could favour us with?—Yes; the conclusion to which I have arrived in brief is, that if the sledging parties had had some class of special antiscorbutic, regularly administered and regularly taken, I do not think that scurvy would have exhibited itself as it did.

5597. Do you think that the two ounces of Edwards's preserved potato which is included in the ration represents a sufficient quantity of antiscorbutic food?—No; the amount of antiscorbutic virtue in dried vegetables has not as yet been accurately determined, and hence it is very difficult to say how many ounces of preserved potato would serve to replace 1 ounce of lime or lemon juice. The scale for convicts at sea includes (or did include) 4 ounces of preserved potato per head; the emigration scale allows 8 ounces weekly; Messrs. Greens' seaman's scale, 4 ounces weekly; and Messrs. Wigram's scale 8 ounces weekly per man; in addition to preserved meats, peas, currants or raisins, and a daily ration of 1 ounce of lime or lemon juice.

5598. You are aware that there is no lime juice represented in that ration?—Yes, I am aware of that.

5599. Do you think that that fact is of importance?—Yes; it struck me as an eminently important omission when I was aware of the fact, because it is the old and acknowledged antiscorbutic which the Royal Navy was the first means of introducing, and when the quality and quantity of it has been assured it has held its own against all others in the Royal Navy, and also the mercantile marine, according to my own reading and experiences.

5600. You have no doubt as to the efficiency of lime juice as an antiscorbutic?—I am still strongly in favour of it, in spite of what I have heard and read in connection with this inquiry out of doors, and speaking generally as to what I have read within the last week.

5601. You have seen nothing in what you have read, either in connection with this expedition or with any other expedition, to modify your opinion as to lime juice being the most efficient antiscorbutic substitute that we possess for fresh vegetables?—Quite so.

5602. You are of opinion, are you not, that the cause of the outbreak of scurvy in this expedition was the insufficient supply of vegetable antiscorbutic food?—Yes.

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5603. You know that in the necessary conditions of these ships during the long arctic winter, the crews were placed in abnormal conditions, such as long deprivation of sunlight, confinement with a necessarily limited amount of exercise, extreme cold, and possibly, to some extent, a vitiated atmosphere?—Yes.

5604. To what extent do you think these different conditions would operate in the production of scurvy?—I should class them only as predisposing or indirect causes of the disease.

5605. Not necessary antecedents?—No.

5606. The only necessary antecedent that you have succeeded in discovering is the absence of lime juice or of fresh vegetable food?—Yes.

5607. We have it in evidence that the proportion of cases was larger among the men than among the officers; from your experience of life on board ship, can you at all account for this difference?—It quite agrees with what we glean in the mercantile marine, that the officers are scarcely ever affected, and if I am asked why, I should say because I think that, as a class, their stamina is generally better, and hence they have more physical resistance to any class of disease, whatever it may be, on the score of their clothing and their manner of life, and a variety of other things that education helps to bring.

5608. Are they at all differently situated, so far as your experience goes, with reference to their dietary, to their medical comforts, or to their accommodation on board ship?—In the mercantile marine all are better as a rule. The diet is better, the accommodation is better, the clothing is better, and all the general circumstances are much better.

5609. To those circumstances, as well as to others

which you have already named, you attribute the comparative immunity of the officers in the merchant service?—Yes, I do.

5610. You are aware that the sledging parties were undergoing, as a rule, extreme exertion at the time when the greater number of cases of scurvy occurred?—Yes.

5611. What influence do you think that physical exertion had upon the occurrence of the cases?—I think it increased their severity, but I should decline to state that it originated the disease.

5612. Have you frequently or ever met with cases of scurvy which had no such antecedent as physical exertion?—Yes, seven out of eight captains of merchantmen will declare that idleness is the chief cause of scurvy. It is always the refuge of the destitute, with the commanding officer of a merchantman, when at the close of my inquiry I ask him what he thinks is the cause of scurvy; "Oh! he says, because they are extremely idle, and scarcely ever wash themselves." That is always the answer, if the case is a bad one, and if he has any idea that I class it as a bad case.

5613. Have you yourself found that filth is an important cause, or any cause at all?—I should class it as a predisposing cause, but not as an exciting cause. For instance, if, as is the case with men in the Arctic regions, they are not able to wash, it would help matters when the disease has originated.

5614. That of itself, of course, in the absence of what you have already told us is the necessary antecedent, would not cause scurvy?—No.

5615. Not even in combination with the numerous other causes which you have conveniently classed amongst the predisposing causes?—I think not.

The witness withdrew.

WALTER DICKSON, Esq., M.D., Staff-Surgeon, R.N., *examined.*

5616. (*The Chairman.*) You are a Staff-Surgeon in the Navy, and hold the position of Medical Inspecting Officer of the Customs?—Yes.

5617. And in that position your attention has naturally been turned to the subject of scurvy?—Yes.

5618. (*Dr. Donnet.*) I believe you have made yourself acquainted with the history of the details of the late arctic expedition and of the outbreak which took place in that expedition?—I have.

5619. Would you give the Committee the result of your opinion upon this outbreak?—I consider that the immediate and direct cause of the outbreak was the privation of fresh vegetable food, or its substitute, lime juice.

5620. Do you think that hard work, fatigue, absence of light, and other causes which operated during the winter months, had any action towards producing this outbreak?—They very much conduced to it. The absence of light, comparatively unnatural diet, extreme cold, and inaction for so many months predisposed the men to the disease; and the great muscular exertion, and fatigue, and the extreme cold and discomfort to which the sledging parties were exposed, developed the disease.

5621. Should you consider them in any way as exciting or predisposing causes?—These were predisposing causes.

5622. Looking over the sledge dietary (*handing one to the witness*), do you consider that the provisions supplied to these parties were sufficient to preserve them in a healthy state of body?—I have no personal acquaintance with pemmican to be able to judge of its efficiency. The other rations seem to be sufficient and well selected, and I only regret the omission of lime juice. The preserved potatoes and onion powder appear to be the only specially antiscorbutic articles of food in the list, but they are in no great quantity.

5623. Is it your opinion that men subjected to a diet like to that which you observe in the sledge

dietary would sooner or later become subject to scurvy?—Yes.

5624. What suggestions would you make towards the improvement of that dietary?—To add lime juice, even were it at the sacrifice of some other article.

5625. And what article would be the one for which you would substitute it?—Rum or tobacco.

5626. It has been given in evidence that rum proved a very comfortable drink to the men before going to their sleeping bags, and many of them attached much value to it?—I can easily believe that to be the case, and I should be inclined only to sacrifice a portion of the rum; to have made the half gill an equal portion of rum and lime juice; or, better still, to have concentrated the lime juice, by which space might have been saved.

5627. I believe that you have had some experience of scurvy; would you give the Committee the benefit of that experience?—I have seen little or nothing of it in the navy, except in a modified or incipient form, but for some years I inspected for the Board of Trade a great many cases of scurvy which occurred in merchant ships arriving in the port of London. The inquiries into the causation of the disease were very elaborate, and embraced all the circumstances of the patients during their service on board ship. In that way I saw a great deal of this disease. The practice was this. Whenever a vessel came into the Thames which had a large proportion of cases of scurvy on board, if the proportion were more than say 10 or 20 per cent. of the crew, it was represented to the Board of Trade, and the Board of Trade gave me a commission to inspect the ship, and inquire into the causes, to examine the master and others, and visit the patients themselves in the hospital, to see the provisions, examine the lime juice, and report fully on each case. On these reports the antiscorbutic legislation of 1867 was based.

5628. From what parts did these ships come?—

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Chiefly from China and India, round the Cape of Good Hope, or from the Pacific, round Cape Horn.

5629. Did you remark any difference in the symptoms of scurvy in the different ships, coming as they did from various parts of the globe?—No. The disease seldom broke out before the ship had left its port 60 days.

5630. Then you think that climate has no influence over the appearance of scurvy?—I have seen no scurvy from vessels employed in cold climates.

5631. I believe you consider that lime juice is an essential towards the warding off of scurvy?—Undoubtedly, in the absence of fresh vegetables and fruits.

5632. Have you any information to give the Committee as to how the lime juice served out in the mercantile marine is made?—That in London I think is chiefly lemon juice; much of it is made in London by the wholesale confectioners, who squeeze the lemon before converting the peel into a preserve. Much of it is imported from the West Indies; that is lime juice; and possibly lemon juice may be imported from the south of Europe, but I am not aware.

5633. Do you think that there is any difference between the properties of lime juice and those of lemon juice?—To most persons the lime juice is more grateful; but I do not think there is much difference in their dietetic properties. Much more depends on the ripeness or unripeness of the fruit. When the fruit is not fully ripe, the juice expressed from it is more acid, and is generally supposed to be more antiscorbutic.

5634. Do you consider that citric acid contains any antiscorbutic properties?—My experience is against it when taken alone. In several of the vessels that I inspected, a solution of citric acid had been given throughout the voyage, and yet the outbreaks of scurvy were very severe.

5635. What standard of age would you establish in the choice of men to be employed in arctic expeditions?—For that and for all service requiring vigour of body and mind, from 25 to 35 is the best age.

5636. Can you give any idea of what cubic space is necessary for men about to be employed on arctic expeditions?—In the mercantile marine the allowance of cubic space is very small, only 72 feet. I recommended 90, but that was considered as too great, and the present allowance of space is 72. That is the allowance by the Act of Parliament of 1867, the Merchant Shipping Act, section 9.

5637. (*Admiral Inglefield.*) When you say 72 feet, you mean that supposing that every man was in his hammock, the division of the cubic space allows to each man 72 cubic feet?—Yes.

5638. But as half the men are on deck at sea, the space would be practically double that, namely, 140 feet?—Yes, it would be so. The matter of cubic space is unimportant where there are plenty of apertures.

5639. (*Dr. Fraser.*) You have just said that you think the matter of cubic space is quite unimportant?—When the place is open to the air in all directions.

5640. The great point is, of course, to give as much fresh air as possible?—Exactly so.

5641. In arctic regions, however, the difficulty in renewing the air within the confined space is very much greater than in more temperate climates, is it not?—Very much greater.

5642. Cold being one great obstacle to that renewal?—Yes.

5643. So that, in arctic regions, it does become to some extent a matter of importance what the accommodation in that respect is?—Of the greatest importance.

5644. Have you had any experience of ventilating ships by admitting air which had previously been warmed?—No.

5645. That process does not exist?—No, so far as I am aware.

5646. Do you think it would possess any advan-

tage in the arctic regions?—Very great; it would be very important.

5647. Do you think that much harm results from breathing a vitiated atmosphere for many months—four or five months, for instance?—Very great harm.

5648. To use a familiar phrase, do you think that it predisposes to other diseases?—Very much.

5649. It reduces, possibly, the standard of health?—Undoubtedly.

5650. Where no other cause of disease exists but a vitiated atmosphere, what is the disease or what are the diseases that you would expect to follow?—There are very few diseases which may not be caused or aggravated by a vitiated atmosphere; but diseases of the pulmonary and nervous system are those which are most likely to follow.

5651. You would not mention scurvy as one of these diseases?—No.

5652. It is not, in your opinion, a disease which has, as a necessary antecedent, a vitiated atmosphere?—No, I believe it to be a purely dietetic disease.

5653. A disease of defective nutrition?—Yes.

5654. And the cause of it, so far as your inquiries go, as you have already told us, is privation of fresh vegetable food?—Yes.

5655. That is your undoubted opinion?—Yes.

5656. You are aware, no doubt, that on high authority it has, at different times, been maintained that a privation of or diminution in the requisite quantity of nitrogenous or albuminous foods may cause scurvy. Has that theory met with any support from your inquiries?—No.

5657. All your inquiries, without a single exception, have led you to this one conclusion which you have stated as being now your opinion on the question?—They have.

5658. You have, no doubt, examined the conditions under which the men in the recent arctic expedition existed, have you not?—I have read various journals of the officers of the late expedition.

5659. You are aware that there was long privation of sunlight, that there was, of course, extreme cold at different times, and that there was confinement in an atmosphere which was possibly vitiated, and other conditions which are not generally regarded as conducive to good health. Do you think that the combination of these conditions could, by any possibility, have in themselves resulted in scurvy?—No.

5660. Are you acquainted with the scale of victualling on board ship during that winter?—Yes.

5661. What is your general opinion respecting that scale of victualling?—I think it was very good. The quantities, I fancy, might have been a little increased sometimes.

5662. It is very important to get your opinion. What things would you mention?—Pork, I think, was given in rather insufficient quantities. It is unquestionably the most relished by seamen, of all articles of diet, and probably the most nutritious. Seven pounds seems to have been the quantity allowed for twenty-eight days. I think three-quarters of a pound of preserved meat was rather too little. In fact, when in the antarctic expedition, I always recommended an issue of salt meat with the preserved meat; it makes a capital combination, infinitely better than either article alone.

5663. On the same day do you mean, the same ration?—Half the ration of salt pork with the preserved meat. I see that in the recent expedition the allowance of pork was latterly increased in practice; so they found that was not quite enough. If you will allow me, this was the list which I drew up and which was recommended in 1867 by the Board of Trade, for the dietary of the merchant service (*handing it in*). That has not been, I regret to say, accepted in its entirety, but in some ships the diet has been modified in accordance with this scale,

which allows preserved meat, soup, and vegetables, in addition to the usual rations.

5664. Are you satisfied on the whole with the amount of vegetable food in the board-ship dietary of the arctic expedition now before you?—I think, with lime juice, it was quite sufficient.

5665. There is only one ounce of lime juice; that is in your opinion a sufficient quantity?—I think so.

5666. What is the ordinary ration in the merchant service?—An ounce is ordered by Act of Parliament. It used to be half an ounce.

5667. Within what period after leaving?—Ten days. "The master of every such ship as last aforesaid shall serve, or cause to be served out, the lime or lemon juice with sugar (such sugar to be in addition to any sugar required by the articles), or other such antiscorbutics as aforesaid, to the crew, so soon as they have been at sea for ten days, and during the remainder of the voyage, except during such time as they are in harbour, and are there supplied with fresh provisions; the lime or lemon juice and sugar to be served out daily, at the rate of an ounce per day to each member of the crew, and to be mixed with a due proportion of water before being served out;" that is section 4, paragraph 5, of the Merchant Shipping Act, 1867. I made it a point of great importance that good lime juice should be issued daily.

5668. I think that the Duke of Richmond's Act has effected great improvement in the health of the merchant service?—I believe it has.

5669. Is that in accordance with your knowledge?—I have had comparatively little cognisance in the last few years of the details, but I believe considerable improvement has taken place.

5670. Does it at all refer to the subject of antiscorbutics?—This article compelling the daily use of lime juice of good quality, is one of the most important in the Act.

5671. And you think it is from that requirement that the greatest benefit has resulted, do you?—I think so in these long oceanic voyages.

5672. You have already, I think, expressed your opinion in reference to the sledge party dietary of this arctic expedition?—Yes.

5673. You had some experience during an antarctic expedition?—Yes, but we did not winter there; we sailed into the highest southern latitudes during the summer of the antarctic regions, from December to April, 1844-45. The "Pagoda," hired barque, and tender to H.M.S. "Winchester" flag-ship at the Cape of Good Hope, was commissioned in December, 1844, for an antarctic voyage, and was, during the summer of 1844-45, engaged in exploring the Antarctic Ocean beyond the 60th parallel of latitude from long. 0° Greenwich, to long. 120° E., viz., one-third of the antarctic circumference of the earth, and for a considerable portion beyond the antarctic circle. The vessel found an impenetrable pack of ice in about 70° S., and for 2,000 miles the navigation was of the most perilous character, by reason of the vast number and enormous size of the icebergs. Important magnetic and meteorological observations were made by the commander, the late Admiral Moore, General Clerk, R.A., and the other officers. I was the medical officer in charge.

5674. Had you any scurvy?—None; excellent health throughout.

5675. Did you experience much cold?—Not much more severe than an ordinary winter. I do not think that we had the thermometer often below + 20°. With a lower temperature we should have been shut up in the ice and lost.

5676. Did you carry vegetables or other antiscorbutics in that expedition?—Yes, we had an excellent assortment of preserved vegetables and preserved meats, and a large quantity of dried fruits, apples, peaches, pickles, and the like.

5677. And lime juice?—Yes, lime juice.

5678. Which you used regularly?—Yes, in double

quantity. At that time only half an ounce was used in the Navy. I always used an ounce.

5679. And you had no scurvy?—No scurvy.

5680. I think you suggest that in order to permit of the carrying of lime juice by sledge parties, a portion of the rum which was carried in the recent expedition might have been dispensed with, and the remaining rum mixed with lime juice?—If absolutely necessary I think it might.

5681. Have you had any experience of that?—No.

5682. Would it be a palatable or an unpalatable thing?—Very palatable. I have seen it preferred in ships to mix the lime juice with rum.

5683. I have no doubt that you are quite well aware that it would have the further advantage that spirit, according to its strength and quantity, would impede the freezing of the mixture?—It would to some extent.

5684. Strong alcohol of course never freezes at the temperature to which it could be exposed in the arctic regions?—I suspect rum freezes partially in a low temperature, but I do not know of that fact. I do not object at all to a ration of rum. I consider a ration of rum a very desirable thing, but I consider that lime juice is even of greater advantage to men than rum.

5685. They can do their work without the rum, but, as your experience has shown, they cannot without the lime juice?—That is so.

5686. You have had some experience, I have heard you say, in reference to the relative antiscorbutic action of citric acid as compared with lime juice, and the result was unfavourable; is that so?—Yes, decidedly so.

5687. That was during your examination of cases of scurvy on board ships, I presume?—Yes; at one time it was quite the fashion, especially in the northern ports, to send out strong solutions of citric acid, as saving bulk and trouble, and not spoiling, but the results were disastrous. Some of the worst cases of scurvy I have ever seen were in ships where that compound, that solution, was daily issued.

5688. Can you tell us what evidence you had at the time that the acid was really citric, and not the cheaper acid, tartaric acid?—At one time tartaric acid was used, but tartaric acid became dearer than citric acid, and citric acid took its place; but I have found in some very bad specimens of lime juice no trace even of citric acid, but of sulphuric and acetic acid.

5689. You satisfied yourself in reference to those other cases that it was citric acid, I presume?—Yes.

5690. By analysis?—Yes; I got the crystals on one or two occasions. I got the crystallised acid from it, and tested it in the usual way. The taste, too, of citric acid is very distinctive; you cannot mistake it. I do not think that elaborate chemistry is required about lime juice; anybody who has drunk a great deal of it, as all naval men have done in their day, will know that the taste and the smell, the amount of acidity, and the specific gravity, are quite conclusive.

5691. Then you do not think, I presume, that it is citric acid which is the efficient agent in lime juice? No, not alone.

5692. Have you formed any opinion as to what is the important element in the lime juice?—I believe it is the acid, but so combined with certain quantities of organic and inorganic matter as to form a mixture inimitable and unimprovable.

5693. Still you do not think that that mixture would be greatly deteriorated by the careful abstraction from it of water, do you?—I think not. In fact, in the navy for some years it was boiled. There is an interesting correspondence of Sir William Burnett on the subject of concentrating lime juice by boiling.

5694. From your experience, gained in the numerous inquiries that you have made, can you

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suggest any reason to account for the comparative immunity of the officers over the men in the recent expedition?—The only thing that I can suggest is, that they had less predisposition by being better fed and better lodged than the men during the long winter, and that they had probably less physical exertion when with the sledging parties.

5695. In reading the papers that you have had, you are, no doubt, struck by the comparatively few cases that occurred in connection with the "Discovery." Have you any remarks to favour the Committee with on that subject?—I think that that was probably due to their having had a larger proportion of fresh meat during the winter; they seem to have had more mutton or beef than the other ship, so that I am inclined to think that although fresh meat is not positively an antiscorbutic, yet in arctic regions it hinders to some extent the approach of the disease.

5696. In short, you think that fresh meat tends to maintain the standard of health, do you not?—Yes; probably that would be the better way of putting it. I do not know whether the ventilating apparatus in the "Discovery" was better, or whether they had purer air. I have seen no account of the interior of the "Discovery." Another point I should mention about the officers is this: I have noticed men-of-war's men are generally very cleanly in their habits, but perhaps they are less so in the arctic regions; personal cleanliness has much to do with outbreaks of scurvy, and officers are more likely to have performed their ablutions. I used to see excessively dirty merchant seamen in the "Dreadnought" hospital ship ill with scurvy.

5697. You, perhaps, have not seen the daily routine on board the ships of this expedition, showing what the men did?—No; then, again, the officers have more intellectual amusements; I think they are less likely to have any disease of a depressing kind, because the mind is more employed. Those men coming from inaction suddenly into such terribly heavy work as hauling the sledges over hummocky ice, is an important fact in the matter, I think.

5698. (*Dr. Donnet.*) Would you not rather say, in reference to the immunity from scurvy which officers enjoyed over the seamen, that it arose from the combined influence which a higher education gives?—It no doubt has considerable influence.

5699. (*Admiral Inglefield.*) Have you formed any opinion as to the proper age of men for arctic service, seeing that you yourself have been engaged on an antarctic expedition?—Yes, I think I have stated that before; 25 to 35 is the best age, I think.

5700. Then have you remarked at all as to fair or dark men, which are most susceptible to scorbutic conditions?—No; the young, I think, are more susceptible than the middle-aged. I have noticed on board scurvy-stricken ships, that the young and old showed the symptoms more than middle-aged people.

5701. Then the extreme young and the extreme old are more susceptible?—Yes. But my experience is confined to seamen in the merchant service, where the range of ages is not very great—say from 18 to 50.

5702. Have you read an account of an extraordinary drift upon the ice of nineteen individuals, of whom two or three were children, one an infant at the breast, from a high northern latitude (Littleton Island) to the parallel of Cape Farewell, and that they had nothing but pemmican and biscuit, besides the seal's meat and bears which they killed, and yet that no symptoms of scurvy broke out amongst them, though they were upwards of six months on the ice?—I have not read that; it is very remarkable if it be so.

5703. To what would you attribute that immunity?—There may be something special, which I do not know, in seals' meat.

5704*. Do you attribute anything to the fact of

meat uncooked being a better antiscorbutic than cooked meat; because it has been given in evidence before us that a great many of the properties which are beneficial and nutritious in scorbutic symptoms in raw meat are dispersed by evaporation or absorption in cooked meat?—It may be so; I have no experience of uncooked meat as food.

5704. Has it occurred to you that lime juice might be concentrated in such a form that it might be carried by the men in the shape of lozenges, and so administered during the sledging journeys?—I doubt whether it could be concentrated into such a solid form as a lozenge. I think it might be concentrated into a much denser fluid than it is; it might be diminished in bulk, but I doubt whether in being solidified it might not lose some of its properties; that is merely a surmise of mine.

5705. Lime juice has been brought before us in various forms, and amongst other things specimens of lozenges have been actually produced in which we were told (subject to analysis, of course) that the whole property of one ounce of lime juice was contained in four very agreeable lozenges?—It would be very useful and convenient.

5706. And if such were the case it would be very valuable to carry on a sledging journey?—Undoubtedly.

5707. I should like definitely your opinion as to whether, if you consider lime juice such a valuable antiscorbutic to be taken on board ship on voyages and in winter quarters, you do not consider it imperative that it should be carried on sledging journeys?—I think so.

5708. And the quantity being one ounce on board ship, what would you suggest as the quantity for the sledging journey?—As much as they can conveniently carry.

5709. Even to excess of an ounce?—I think an ounce would be adequate.

5710. But that, instead of the ration being reduced one quarter, it should be equally large with what was given during the time when the men were living a comparatively indolent life?—Yes, equal to what they had on board ship.

5711. And it is your opinion that exertion tends to develop latent scurvy in the system?—Yes; over-exertion, fatigue.

5712. Do you attribute much to the darkness in the arctic regions?—I think so; I think it does a great deal to depress the vitality.

5713. As a physical effect or a mental one?—Both.

5714. Have you any opinion as to whether potatoes, when they are cooked or preserved, lose any of their antiscorbutic qualities?—Experience is quite against the old idea that raw potatoes are better than cooked. I do not consider preserved potatoes equal to fresh.

5715. Then we have heard also in evidence that the Americans do not issue lime juice to their ships on foreign voyages, but that they give large quantities of potatoes steeped or preserved in molasses, and that they are eaten greedily by the men as a delicious kind of potato salad. Do you consider that would be a good antiscorbutic?—I should think excellent.

5716. As good as lime juice?—I do not know. Lime juice is so excellent, that nothing could be better, I should think. My impression, however, is that we do not use molasses half enough in our navy; it is an antiscorbutic, and with pork forms an excellent dish.

5717. What is your opinion with reference to preserved milk as an antiscorbutic?—I do not think it has any specific antiscorbutic virtue.

5718. Would you recommend it for a dietary?—Undoubtedly.

5719. Is there anything else which you could suggest as a good antiscorbutic which has not been suggested?—A very common fruit, a cheap fruit, very much used by some nations, is cranberries.

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5720. Have tamarinds been brought before you? That is a very good thing, but none of these things are better than lime juice, or so convenient. Lime juice is cheap and manageable, and keeps better than these things. We had, in the antarctic expedition, dried fruit, peaches and apples.

5721. Have you formed any opinion with reference to the qualities of tea and rum for sledge journeys comparatively?—Both are very good.

5722. To which would you give the preference?—If one must be sacrificed, I should say it should be the rum; but I should be very unwilling to sacrifice the rum. I consider it a very desirable addition, not for any peculiar physical advantage it gives, but for its moral effect, so to speak, in making men cheerful and contented. Talking of fruits as antiscorbutics, the old writers are full of valuable observations on the subject; they found a great difference in apples; that the ripe apple had little antiscorbutic property, but that the unripe apple had very marked antiscorbutic properties. So, in the same way, with lemon juice; if the lemons are very ripe, the juice, I take it, is not so good; and I should like to know the quality of the juice supplied to these arctic ships. I found, in my experience, that our navy lime juice was inferior sometimes to the lime juice given to the merchant service, and I attribute that to its having been squeezed from over-ripe lemons in Sicily. At that time our navy lime juice came from Sicily. I used to find, in the merchant

service, 40 grains of citric acid in an ounce of good lime juice, and I remember one or more specimens of navy lime juice, which did not nearly come up to that, but were under 30.

5723. (*The Chairman.*) Will you give the date of that?—From 1864 to 1867, at the time when I was constantly engaged in prosecuting these inquiries.

5724. May I understand that scurvy is a blood disease, caused by a deficiency of fresh vegetable food?—Yes.

5725. And that cold, fatigue, and malaria, and syphilis, may aggravate the malady, but cannot alone produce it?—Yes.

5726. That fresh vegetables and fruit prevent scurvy, and also alone can cure it?—Yes.

5727. Assuming that a daily allowance of lime juice could have been administered to the sledge parties of the recent arctic expedition, are you of opinion that the outbreak of scurvy would have been delayed?—I am.

5728. Are you further of opinion that it might or would have been averted altogether?—I do not think it would have been averted altogether, inasmuch as lime juice after all is only a substitute, but its administration would have modified and mitigated the disease.

5729. (*Dr. Fraser.*) You made an interesting remark in reference to potatoes, as contrasting the raw with the cooked; do you think that the cooked are quite as valuable antiscorbutics as the raw?—Yes.

The witness withdrew.

Adjourned to to-morrow at 11 o'clock.

SATURDAY, 27TH JANUARY, 1877.

PRESENT:

ADMIRAL SIR JAMES HOPE, G.C.B., in the Chair.

ADMIRAL SIR R. COLLINSON, K.C.B.

VICE-ADMIRAL E. A. INGLEFIELD, C.B., F.R.S.

JAMES J. L. DONNET, Esq., M.D., Inspector-General of Hospitals and Fleets, R.N.

THOMAS R. FRASER, Esq., M.D., F.R.S.E.

H. J. VANSITTART NEALE, Esq., Secretary.

VICE-ADMIRAL ERASMUS OMMANNEY, C.B., F.R.S., *examined.*

5730. (*The Chairman.*) From the return which you have been good enough to furnish to the Committee, I observe that you made one sledge journey from the "Assistance" in latitude 74° 34' north. I further observe that on this journey you left your ship on the 15th of April, 1851, after one winter in the ice, returning on the 14th of June, after an absence of 60 days, during which you were detained 10 days by stress of weather, having travelled 557 miles, at an average daily rate of about 9½ miles, in a temperature varying from +40° to -39°, averaging +3°, with generally heavy gales?—Yes.

5731. (*Admiral Sir R. Collinson.*) With respect of the warming and ventilation of the "Assistance," will you describe to the Committee how the vessel was fitted and the steps you took to ventilate the lower deck?—I should first say that my senior officer, Captain Austin, was a man of a very large amount of experience, and a man of very great detail, and a man who studied the health and efficiency of his crew more than any officer I ever met with in the service, and one of his great points was studying the ventilation of the ship between decks. To keep a pure air during the winter, we used to keep the deck as clear as possible during the day time. We did not close up all the apertures of the

lower deck, we endeavoured to keep a circulation of air as freely as possible by always keeping a certain aperture of the hatches open, and a Sylvester stove going; the apertures were not closed unless it became a very uncomfortable and extreme cold temperature. I think the temperature of the lower deck used to range at about 49° to 50° during the winter.

5732. Had you then what we have called here downtakes and uptakes?—Yes, we had some large cowls fitted for carrying off the vitiated air, but I think there were no downtakes any more than opening the hatchways.

5733. You mentioned the Sylvester stove, did the air from the Sylvester stove escape into the cabins and on to the lower deck?—Yes, there were apertures in the officers' cabins and also around the lower deck.

5734. Do you think there were apertures into the officers' cabins?—Yes.

5735. Or only at the end?—They were at the end as well, apertures were fitted.

5736. You could admit hot air into your sleeping cabin, could you, from the Sylvester stove?—The warm air flues did not extend to the captain's cabin. It is somewhat difficult after 26 years to go back to

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very minute details, but, so far as I can remember, I am almost certain that they had means, in fact I remember some of the officers complaining that it was a little too much hot air for them at times.

5737. Had you much moisture on the lower part of the upper deck beams?—We used to counteract that a good deal by this circulation of air. This was our routine through the deck, from a memorandum which I have found in my private journal. "We used to lash up the hammocks at 6 a.m.; 6.30 a.m., all hands are sent on deck to procure fresh air; in the meantime lower deck is ventilated; 7 a.m., lower deck is cleaned, and people wash themselves; 7.45 a.m., muster by divisions." I always went round the lower deck every morning, with the first lieutenant, to see that the deck was dry and everything in its place, then I read prayers on the lower deck, and then they went to breakfast; then all hands were employed up to dinner-time at some work or other, some in the open air, and some on board. The officers were in five watches, and then we mustered again at divisions every evening at 6 o'clock, and saw that the decks were all in order.

5738. Was the moisture on the lower part of the upper deck ever frozen?—No, only on the surface of the bolts coming through.

5739. Did the men suffer from the wet dropping upon them from the beams, after they had turned into their hammocks?—That was never reported to me, and I should say not.

5740. Did you ever suffer, in your cabin, from the water dropping from the beam upon your bed?—No.

5741. Or did any of the officers?—I never heard of it. My cabin was the coldest part of the ship, because the heating apparatus terminated at the extremity of the officers' cabins. I was dependent upon the cabin stove for my heat, but in the morning I never remarked it being much below freezing point. I occasionally had the water in my jug frozen on getting up, but that was exceptional.

5742. With respect to the diet, can you inform the Committee whether it is in accordance with the diet list as given for the "Alert" and the "Discovery"?—It corresponds very much, I think, with Sir James Ross's, with the addition of a few extra antiscorbutics and condiments, and other additions made by Captain Austin beyond what Captain Ross had.

5743. What was the allowance of preserved meat, when you issued it?—Three quarters of a pound.

5744. Was any soup issued with it in addition?—Not on the same day.

5745. What was given on the same day with the three quarters of a pound of preserved meat?—I see from this scale that on Mondays we had three quarters of a pound of preserved meat, and half a pound of preserved vegetables; then another day I see we had three quarters of a pound of preserved meat and half a pound of preserved soup; that was alternately with three quarters of a pound of preserved meat and half a pound of preserved vegetables.

5746. On the salt meat days what was your allowance of meat?—Three quarters of a pound.

5747. How much flour?—I see that it goes under one heading, "biscuit, flour, or rice 1 lb." issued daily. Rice was not liked by the men; it was seldom given. I have here the weekly return of the paymaster for one week, of what was issued during the week. We were 60 men, and during the week there were issued 41 lbs. of bread; spirits, 10-17 gallons; salt beef, 160 lbs.; salt pork, 94½ lbs.; flour, 300 lbs.; suet, 7½ lbs.; preserved meat, 183 lbs.; sugar, 112½ lbs.; cocoa, 19 lbs. 11 oz.; tea, 5 lbs. 1 oz.; soup, 61 lbs.; vegetables, 30½ lbs.; potatoes, 91½ lbs.; peas, over a gallon; then we had a certain amount of barley; then pickles, 22 lbs.; mustard, 5 lbs.; lemon juice, 26 lbs. 11 oz.; apples, 15 lb. 4 oz.; beer, 17½ gallons. That was one of the weekly returns of the paymaster in the month of March, 1851.

5748. That was your average diet throughout the winter?—Yes.

5749. What was the state of the health of the

crew of the "Assistance" after the winter was over?—I should say we scarcely knew what it was to have a man on the sick list. I have got an entry on Christmas-day: "Not a man on the sick list." I do not remember there were ever more than one or two.

5750. Had you any symptoms of scurvy?—Never from the time we left England until the time we came home.

5751. Had you to recommend a diet for a ship's crew for an arctic winter, what change would you make in that which you used on board the "Assistance"?—Everything was so excellent and so good, and so ample, that I could not recommend anything. I remember there were some few things I recommended to the Admiralty after coming home (perhaps a little more frequently preserved green peas, and things of that sort), but it was very trifling; everything on the whole really was most excellent.

5752. Your men started in good health for the sledge journey?—In perfect health.

5753. Will you inform the Committee what was the diet used by you on that sledge journey?—I see one preparation that we made previous to sledging, in order to prepare the crews for sledge work, was, that on the 1st of March we commenced an extra issue of 1 lb. of preserved potatoes, and half a pint of beer daily per man; and on the 7th of April, I observe in my journal, that all the travellers had a good bath of warm water. This was the scale that was issued for the travelling parties:—¾ lb. of bread, 6 oz. of cold pork, which was boiled previous to setting out, 1 lb. of pemmican, a gill of rum, a ¼ oz. of lime juice, with a ¼ oz. of sugar; then there was tea or chocolate alternately, and then sugar for ditto; tobacco ½ oz., then a small quantity of pickles, and salt and pepper, and there was also some bread-dust.

5754. Did you carry any preserved potato?—I did not myself take any, but some of the other parties did. I think some of the officers who had gone out on the previous autumn sledge journeys had the option of taking it, which some of them did. I do not think that any from my ship did. It appears that some from the "Resolute" did.

5755. After an absence of sixty days, and considerable labour, what was the condition of your sledge crew on getting back to the ship?—We all came back in the most perfect health; I may say I do not know that any of us were on the sick list. We gave everybody a couple of days to themselves when they came back, just to clean down and put to rights, and we gave them baths, some fresh meat, that we reserved during the winter, was served out to them, and in a couple of days they all went to their duty; the only thing they suffered was from snow-blindness and a few frost-bites.

5756. You had no symptoms of scurvy whatever?—Never the slightest; we scarcely ever thought of sickness the whole time, we enjoyed such perfect health.

5757. When you were away upon the sledge journey, did you take the lime juice regularly?—We did not. I should state that we did not issue it as a ration; a certain amount was certainly considered absolutely desirable to take with the sledges, but it was regarded merely as a sort of medical comfort, or to resort to in a case of necessity.

5758. You had it on the sledge with you, and we have evidence to say that some of the officers took some, and I think some of them used it?—I think Hamilton and Aldrich and Ede told me they took it. Really speaking most conscientiously, I cannot remember having used it myself, although I see in my return that it was put on board the sledge. I know the subject was considered; we had a conference together in December with Captain Austin and the officers, and those men who had been travelling in the autumn, in order to take the benefit of their suggestions, as to any improvement that they could suggest with regard to provisioning gained from their experience when putting out of depôts in the previous

autumn. On the subject of lime juice, there was much importance attached to it by several, for I see here all the names of the men, and their evidence, with what they say to Captain Austin in his cabin, when he asked them what they would suggest, just to show that they had used it in the autumn sledges. Here is one man, William Swaney, he says, "Very badly off for drink; could not refrain from frequently eating snow, which made the mouth bleed. Lime juice very desirable; would gladly drag additional weight of it and fuel." Thomas Ransom says: "Provisions sufficient, although short of water; many of the people obliged to eat pieces of snow. With Sir J. Ross; hard up for water until latter end of May, when it began to make lime juice very desirable." Then here is William R. Huggett, who says: "Lime juice very desirable." Joseph Organ says, that he "considers lime juice most important." Those are the suggestions of the men who had been out on the autumn party. You have asked me about the men on the sick list, and I said there were none on Christmas-day. I have here a note from my journal on the 5th January, 1851, which says: "Only one man in sick list. By constant attention, a pure ventilation and dryness is maintained between decks." Then I say in my journal, on the 12th of January: "All the internal economy for ventilation and comfort are still more satisfactory; between decks we are dry and well aired. The best health and spirits continue to be enjoyed throughout the expedition." We grew a little mustard and cress, and on the 18th of February I see that we "issued a dish of fresh mustard to each mess, grown in the hold; 1 lb. of seed yielding 6½ lbs. of vegetables." I also see two or three entries in the log, where we issued cress grown in the main hold. Then I see, on the 3rd of November (taking the whole four ships together): "Out of 182 persons composing the expedition only four out of the number on the sick list. This happened to be the last day on which the sun was visible in this year."

5759. So far as you can remember, you had no difficulty in carrying the lime juice?—No, not that I remember; I see some carried it in tins, and some in stone bottles, and I heard of some of them having broken their bottles. I see Mr. Hamilton had lime juice and sugar in two bottles. Dr. Bradford had his lime juice in a bottle. MacDougall had 20 days' lime juice in a bottle. I see Osborn had lime juice and sugar, 10 lbs., in 8-lbs. tins. Lieutenant Aldrich had on his sledge lime juice for 60 days, and he has got a tin of lime juice, weighing 17½ lbs.

5760. From those journals, you had evidently no difficulty in carrying the lime juice?—No; in my own return I have put down, "lime juice in two bottles, 14 lbs.," yet I am free to confess that I cannot remember having touched it.

5761. (*Admiral Inglefield.*) Did the men take their lime juice regularly, summer and winter, and on the quarterdeck, in the presence of the officers?—Not on the quarterdeck, certainly.

5762. It was allowed to be carried to their messes?—Yes; there was such a good understanding between everybody, that none of those compulsory measures were necessary.

5763. In some of the expeditions, I believe, the men did mix it with their grog, and drank it on the quarterdeck, but that was not so in your case?—No; I think that generally it was so much liked that there was no necessity for those compulsory measures.

5764. We have it in evidence that one man in the "Alert" was not administered by the doctor; my reason for asking you is to know whether all your men took it?—No complaint ever came before me; any objection of that sort, of course, would have to come through the first lieutenant, but no report was ever made to me.

5765. When the sledge parties were sent away, was lime juice always issued to them?—Yes, it certainly was.

5766. And what quantity was it the rule to issue? Vice-Adm. E. Ommanney, C.B., F.R.S.
—The scale of allowance issued was about a quarter of an ounce a day. The scale was drawn out in February, in accordance with the scale drawn up by the senior officer, Captain Austin. 27 Jan., 1877.

5767. When it was issued to the men, was the snow thawed and the lime juice mixed with it, or was it mixed with their grog?—I expect it was generally taken at the luncheon time, and mixed with the grog whenever it was taken. Of course, in extreme low temperatures I do not suppose that they thawed it; but I see, from a note here, that provision was made for a party that went out in February, 1851, only going a short distance to Assistance Bay, which is only 20 miles off, and even then they were compelled to take lime juice with them for that short journey.

5768. As a matter of fact, lime juice, in the proportion of a quarter of an ounce per man per day, was issued upon all the sledge journeys with which you were connected, or over which you had any control?—Yes; that was the rule certainly.

5769. And no symptoms of scurvy occurred on your expedition?—None whatever.

5770. Did the officers on the sledge journeys, like the men, occasionally draw at the sledges?—No. There were one or two exceptions. I remember the engineer of the "Pioneer" volunteered and worked as a man the whole journey with Osborn's sledge; also I took a pull occasionally myself.

5771. In your experience of sledging, do you give the preference to tea or rum for issuing to the men; which seemed to have the greatest effect?—They would take both. On some occasions they preferred a warm drink to the rum; but I certainly would never think of doing away with the rum on any account.

5772. Was tea found better to take at the mid-day meal than rum?—No; I never attempted it in the middle of the day. I never gave tea in the middle of the day; only rum. I never thought of it; after tenting was the best time to enjoy it, and make it. The men looked forward to the rum as a comfort.

5773. Did you find that they travelled equally well upon the rum as they did upon the tea?—As I say, I never tried tea in the middle of the day; I mean the luncheon time.

5774. In what condition were your men at the end of your voyage, after having spent one winter in the arctic regions; would they have been able to have well stood out another?—They were perfectly competent, and quite in a condition to pass another winter there very well.

5775. Did you find much sorrel or scurvy-grass in your journeys?—The only time that I got it in any quantity was at Carey Islands, at the end of August, on coming home. We then, I think, collected a considerable quantity in bags, and brought it off to the ship for issue.

5776. And the men, I presume, ate of it freely?—Yes, but that was the end of August, 1851.

5777. Have you formed any opinion as to the proper ages of men for arctic service, and can you give the Committee any idea of the limits of ages in your own ship?—I should think that there were scarcely any above 35; I should say the average would be about 28 or 30.

5778. Had you many temperance men in your ship?—Not one that I can remember.

5779. Did you try compressed tea, which is now issued in a very condensed form, in the shape of a brick?—No.

5780. Did you ever hear of scurvy amongst the Esquimaux?—No; they are carried off, I believe, very frequently by some sort of epidemic.

5781. Were any musk oxen killed on your parties?—None. McClintock met with them at Melville Island when sledge travelling.

5782. Does anything occur to you which you can state to the Committee, with reference to the cause of the outbreak of scurvy in the recent arctic expe-

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dition?—I have simply read Captain Nares' public report, which has been printed, and had some general conversation with the officers. I have not enquired into any detail as to the arrangements. I think a great deal of importance is to be attached to the ventilation maintained between decks, to frequent exercise, and strict routine, and regular hours for meals.

5783. But admitting that all that was according to the approved regulation laid down, do you attribute anything especially to the prolonged darkness, the excessive cold, and the excessive fatigue?—The conditions of darkness, fatigue, and cold, no doubt would tend to produce it, I dare say.

5784. And that, in fact, the outbreak was the result of those all being in excess?—I do not know whether I could state that; they would be conducive to it probably, but I do not see why the excess of fatigue should be accompanied with scurvy, if they were well fed and in good spirits.

5785. Would you impute it to the want of a sufficient quantity of lime juice being administered?—I presume that they were in the habit of taking it, as we did, every day.

5786. Not on the sledge journeys; it is pretty clear that none was taken on them in the recent expedition?—Of course, some of our people took it, and some did not; it seems to have been optional. I know that we made provision for taking it. I see that in May, 1851, I did not take it.

5787. But the men could partake of it if they wished it; it was there, but it was not compulsory?—It was not compulsory.

5788. But it was served out so as to admit of their having a quarter of an ounce a-day?—Yes.

5789. (*Dr. Fraser.*) The expedition of which you have been speaking was that of 1850-51, was it not, in which you accompanied Captain Austin?—Yes.

5790. Had you, whilst wintering, very prolonged darkness in that expedition?—The sun was absent for 95 days.

5791. Whilst wintering, was the cold very great?—I can give you for each month the maximum, minimum, and mean temperatures. In November, the maximum was $+14^{\circ}$, the minimum, -30° , mean, 6.9° . In December, the maximum was -4° , minimum, -39.5° , mean, -22.2° . In January, the maximum was -11° , minimum, -47° , mean, -31.9° . In February, the maximum was -13° , minimum, -48° , mean, -32.9° . In March, maximum -9° , minimum, -45° , mean, -26.6° . I have a note of the mean temperature between decks during those months, and I find that the mean temperature of my cabin for November was 45° , on the lower deck, 51° . The mean temperature of my cabin for December was 44° , of the lower deck, 51° . In January, in the cabin, the mean was 43° , in the lower deck, 49° . In February, in the cabin, the mean was 41° , in the lower deck, 49° . In March, the mean in the cabin was 45° , on the lower deck, 48.5° .

5792. You apparently were able to maintain a comfortable temperature on board ship?—Yes, we were.

5793. How was that accomplished?—By the means which I have already stated. By a judicious application of the Sylvester stove, and admitting a certain amount of fresh air to keep the circulation between decks; uptakes were fitted with cowls for carrying off the vitiated air.

5794. The fresh air which was admitted was not heated, was it, before it was distributed between decks?—No; not the fresh air from the hatchways, but fresh air was conveyed into the Sylvester stove previous to heating.

5795. Was your scale of victualling on board ship similar to that of the recent expedition?—Yes; very similar.

5796. Had you both preserved and compressed vegetables?—I do not remember the compressed vegetables. I do not think they were in use in those times.

5797. Can you remember what your preserved vegetables consisted of?—We had a very large por-

tion of carrots, green peas, some parsnips; and we had a very large allowance of Edwards's preserved potato, which was liked very much indeed, and was most excellent. I have a report on the return of the expedition to England, with reference to Edwards's preserved potato, and I think the merits of it have been generally accepted by nearly every expedition since. We say, "As a substitute, I consider it of great value at sea. It was highly prized by the travelling parties to mix with their pemmican; and was much valued as an article of general issue by the ship's crews, being preferred to either rice or carrots; and it is but fair to assign to this article (with other measures), its due proportion of merit for the total absence of scurvy in the expedition."

5798. Your ration of lime juice was an ounce per diem on board ship?—Yes.

5799. You were not fortunate in obtaining fresh meat or game, were you?—No. It appears that our position seemed to be singularly unfortunate as regards any supplement from game or animals killed; and I think we derived less benefit from game than any expedition in arctic exploration, as far as I can see from reports.

5800. The quantity was smaller than in any previous or subsequent voyage?—Yes; all that we partook of when travelling was two birds during the 60 days, and, I find, on looking over the returns in the place where we passed our winter, the whole amount of creatures that we killed did not amount to an issue of a bird a man to the whole ship's crew for a whole summer.

5801. During the winter, had you any game?—No; we occasionally caught a fox.

5802. In summer, had you any game?—Only what I have alluded to.

5803. At the end of the winter, the health of your men was, I understand, very good?—Yes, very good indeed.

5804. You had no serious illness on board ship?—Nothing at all.

5805. Had you no deaths?—None on board the ship and tender under my command. One death occurred on board "Resolute," the result of frost-bite when travelling.

5806. Had you frost-bite during that winter?—The only frost-bite, of any serious nature, was in the sledging parties; but not in the winter.

5807. In fact, you cannot remember any illness at all of a serious kind during the winter?—No, we enjoyed the most perfect health and spirits the whole time.

5808. When did your sledge parties start from the ship?—On the 15th April, with one or two exceptions; there was a small party went out on the 18th of February to communicate with Penny's ships, a distance of twenty miles off, the thermometer being at -47° , I observe in my journal.

5809. The general start was on the 15th April?—Yes.

5810. Before this general start, did you to some extent accustom your men to sledge travelling, and to the hardships of sledge travelling?—We commenced in March, when we used to send everybody out in travelling over the ice, to walk perhaps 10 or 12 miles, and they would be away between three and four hours at a stretch; and we practised them in sledging, by drawing a certain amount of ballast from Griffiths' Island, about two miles off.

5811. Did you endeavour to avoid an abrupt change from the comparative inaction of winter to the extreme physical exertion of the sledging season?—I do not recognise that we had any particular inaction during the winter. Our object was to give everybody a certain amount of work every day.

5812. I say comparative inaction; I mean comparative abstinence from extreme physical exertion, which was present, of course, during the sledging?—It was so far gradual, that we commenced by those walking parties over the ice and dragging the sledges. Of course, with the return of light, people are able to

walk further; but it was a rule, during the whole winter, that everybody should take an amount of exercise on the ice near the ship, even those whom we term idlers in the navy; everybody was to be three or four hours in the open air; including stewards and cooks. We were very particular also with regard to cleanliness; it was ordered that everybody mustered clean in the morning; and I had an arrangement that everybody should clean the whole of his person once a fortnight.

5813. Was that done under supervision?—Yes; their names were taken down by the officer of the lower deck, and given in to the first lieutenant, that this order had been complied with, so every person's body was thoroughly cleaned once a fortnight. Then we had the airing of the bedding as well, which was insisted on. Each mess once a fortnight aired their bedding. We also insisted upon every man wearing a waistbelt.

5814. Did you remark any change in the complexion of the men after the darkness of the winter?—Not to that extent for which I was prepared from reading accounts of former voyages. It was nothing very striking.

5815. Was there any paleness or blanching?—I should not call it blanching. They might have been a little paler perhaps, but not more than some of those creatures that we see about the streets of London after a winter.

5816. I will show you the sledge dietary of the recent expedition (*handing the same to the witness*). Will you kindly inform me if that corresponds with that of your expedition, and, if not, in what respects generally it differs?—I gave all our routines and other matters connected with our internal arrangements to Captain Markham before they left England. I see that there is one difference, that they provided for carrying potatoes, which we did not. As I said before, some of our parties did take preserved potatoes with the permission of the senior officers, and some did not.

5817. Can you tell us if your sledges carried lime juice?—In the returns which I have before me, each of them is entered in the return as carrying it with them.

5818. And in none of the sledging parties, I think you have told us, had you any scurvy?—None whatever.

5819. So that those sledging parties, which you know did carry lime juice, did not suffer from scurvy?—They did not, as already stated.

5820. You yourself were absent on a long expedition of sixty days?—Yes.

5821. Had you many difficulties to encounter in the way of overcoming obstacles?—It was more or less laborious. Sometimes the snow would be six or eight inches deep, and sometimes there was hummocky ground to contend with.

5822. You have seen the accounts, I dare say, of the extended sledging parties in the last expedition?—Yes.

5823. Do you think that their difficulties were very much greater than yours?—Certainly; from the different nature of the ice.

5824. The fatigue which they underwent was probably more than that undergone by your party?—I presume it was. One rule I made was never to over-exert any one; I always avoided over exertion.

5825. Had your sledging parties any fresh food in the way of game?—As I have said before, the only things that we partook of were two birds, and I suppose I ate the principal portion of those.

5826. Were the men examined by the medical officer on their return from the sledging parties?—Yes.

5827. His report was entirely satisfactory, was it?—Quite so.

5828. Not the slightest suspicion of scurvy, for instance, was suggested?—Never.

5829. There was no extreme debility, was there?—None.

5830. There were no rheumatic pains, or pains resembling rheumatic pains, so far as you can recollect?

—There was one of my men, the captain of a sledge, who occasionally complained of pains in his body, that may have been of a rheumatic nature, that was all, and that was merely temporarily, it passed away, and he came on board well.

5831. He had those symptoms whilst sledging?—Yes.

5832. And they disappeared before the sledging was over?—Yes; I have a return here from the paymaster, who had to give a return of the quantity of provisions which each sledge brought back to the ship on return from journeys, and I see, just to show that lime juice was the rule, he enters "lime juice," and against that he puts "none returned," after coming back. I cannot say what became of it, except from the statements of the officers.

5833. Judging from that return, it had been consumed?—I do not know, except from the statements of the officers.

5834. It must have been either consumed or thrown away?—One or the other.

5835. Can you remember if you carried condensed or preserved milk in your sledging expeditions?—Yes; Moore's preserved milk, and an excellent thing it was.

5836. It does not appear in your scale?—No, it does not. I recollect we had one or two cases that were thrown in extra just before we started. I see in my private journal I alluded on one occasion to the enjoyment of taking this milk.

5837. Was it frozen while carried?—It must have been frozen.

5838. You had no difficulty, as far as you can remember in using it, had you?—No, I do not remember any.

5839. No insurmountable difficulty, at least?—No.

5840. Did you yourself ever see lime juice used by the men in any sledging expedition?—I cannot remember having done so. I think whenever they took it, it was probably at luncheon time, it was probably thrown into the grog. That was the only way it was taken.

5841. You never heard any complaint of the impossibility of thawing the lime juice, did you?—No.

5842. I think you have told us that the ration carried was about equal to a quarter of an ounce per man per day?—Yes, that was the arrangement.

5843. Have you read the papers connected with the recent expedition, or which of them have you read?—I have only read the official report of Captain Nares.

5844. Then you are not, perhaps, acquainted with all the facts?—I have not seen any of the reports of the sledging expeditions.

5845. Have you formed any opinion from the not complete knowledge which you possess upon the subject as to the probable cause of the occurrence of scurvy in the last expedition?—As I said before, those three conditions, over exertion, the length of the darkness, and extreme cold, might have been conducive; of course it puzzled me very much, as it did every other arctic officer of experience.

5846. And you say these causes might conduce to it?—Yes, they might conduce to it. I cannot account for it in any other way, except from atmospheric causes.

5847. Is it your opinion that all these conditions, apart from some other condition as to which you perhaps have not made up your mind, would in themselves account for the outbreak?—I believe living in the bad atmosphere would be, of course, a very material cause of scurvy, more so than any other.

5848. Do you mean the cause specially of scurvy, or a cause of lowering the standard of health generally?—Of scurvy, I think, from what I have read. I think in former voyages, where they thought they would keep warmer by closing every aperture to exclude the fresh air, it was very conducive to scurvy, by their living in a bad atmosphere, and by the formation of moisture between decks.

5849. You are aware, of course, that along with that bad condition of the atmosphere, there were general faults in the dietary in those former expedi-

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tions?—Sir James Ross's dietary was very good in the expedition previous to us, where they had some cases of scurvy.

5850. Still, you know that there are large masses of people on shore, who live habitually in extremely vitiated atmosphere, without having scurvy?—Yes, I believe so; and on the other hand I have heard of scurvy being met with in prisons.

5851. You probably may have also heard of scurvy being met with among troops while camped in the open air?—No, I have not heard of that.

5852. Did you carry any eggs with you?—No, merely that perhaps the officers in our own mess might have just a private stock at starting; we procured a few in Baffin's Bay from some eider duck's eggs.

5853. Was the preserved milk that you used in a dry form, what is called desiccated, or was it the ordinary condensed milk, do you remember?—It was preserved, in a thick consistency, we dug it out with a spoon.

5854. Was it used as a ration on board ship during the winter?—Not actually as a ration; I think it was liberally used at the recommendation of the medical officer as a medical comfort.

5855. You are aware probably that in the recent expedition, the number of cases among the officers was very much less than among the men?—Yes.

5856. Can you give the Committee any suggestion in any way to account for that difference?—I think it was, perhaps, the nature of the atmosphere between the officers' quarters and the lower deck during winter. I do not know whether the space in those ships, where the men lived, was more contracted than in our vessels. I should say that I think the ship which I commanded, the "Assistance," is one of the best ships for arctic service that ever went out. She was a very old teak ship, and excessively dry, and very spacious.

5857. Can you mention what cubic space the men had?—I do not exactly remember. I see also that I have got the opinions of ten of the men of the "Assistance," which were taken before the travelling. Those men had been out in short parties, and they also say that they should like to have lime juice in the forenoon, which would be their luncheon time.

5858. What was the total number of men in your expedition?—The total number of men in my ship, and in the "Tender," was 90 officers and men. In the whole four ships there were 182, and I had one Esquimaux, whom I took on board.

5859. Was there scurvy in the other ships, as far as you know?—I did not hear of any.

5860. Could you give us any statement of the weights carried by your men during sledging?—This is a return of the weights carried by each man at the start (*delivering in the same*).

5861. These weights were rather diminished than otherwise, were they not?—Yes, they diminished daily.

5862. Were your sledges all man-sledges?—Yes; we had no dog-sledges.

5863. Can you tell us how many sledges were sent out?—The division to Cape Walker and Prince of Wales' Land, that went under my command, were seven in number; seven officers and forty-five men.

5864. The sledges from your ship constituted the southern division?—Yes, south-western.

5865. And from the "Resolute" the western division?—Yes; towards Melville Island.

5866. And there appear to have been seven sledges connected with each division?—Yes.

5867. Can you tell us about what the extreme weights dragged by each man were in those expeditions on starting?—I see that on my sledge each man carried 207 lbs., and in the smallest sledge 190 lbs., a difference of 17 lbs.

5868. In the western division can you also give us that information?—One of them set off carrying as many as 224 lbs. at starting, and the lowest figure is 196.

5869. And this weight was gradually diminished according to the progress of the parties?—Yes.

5870. You have already told us that you had no interference with that gradual diminution by the men being disabled and requiring to be carried, or ceasing from doing their fair share of the work?—At first starting there was one of those very severe cases of frost-bite, who was changed with a man from the auxiliary sledge, and sent back to the ship.

5871. With that exception, if it does constitute an exception, the weights gradually diminished throughout the journeys?—Yes; here is a return from the surgeon, Dr. Donnet, which shows the amount of casualties and of frost-bites (*delivering in the same*), and I have also a return dated the 5th July; it is the sick list at that time, which shows that those were merely people suffering from frost-bites.

5872. From the return which you have just shown me there appear to have been six cases of men suffering from frost-bite?—Yes.

5873. That represents the total serious illness at the end of your sledging expeditions?—Yes, that is all.

5874. How many men were engaged in these sledging expeditions?—Forty-five on the South-western Division, under my command, 7 officers, 45 men; on the North Division, to search shores of Parry Islands, and to Melville Island, under Lieutenant McClinton, 7 officers, 45 men; on Hydrographical and reserve, 3 officers, 24 men. Total employed on the expedition on sledging service, 17 officers, 114 men. Here is the report of the medical officers, dated 10th July, on the state of health of the ship and the tender (*delivering in the same*), and here is a receipt for making sugar beer, which we made on board, and which was used extensively (*delivering in the same*).

5875. Generally speaking, these two reports from the medical officers were very favourable?—Yes. I suppose nobody ever had the honour of commanding a finer set of officers and men than I had, and a finer set never went out on arctic expeditions.

5876. (*Dr. Donnet.*) What was the position of your ship during winter quarters, was it in a closed harbour near the shore, or on the open floe?—We were not fortunate enough to get into a harbour to pass our winter, we were frozen up in Barrow Straits in the open floe. If there had been any harbour, no doubt we should have been able to have got much more room between decks than we had; we could have got more things out of the ship, and therefore, in that point of view, our position was unfavourable.

5877. Was the cubic space from this circumstance rendered less?—If we had been in a regular harbour, we should have had more space, no doubt.

5878. Do you think that the ship was rendered more cold by its position?—Than if we had been in a regular harbour surrounded by land, do you mean?

5879. From the greater exposure to the winds?—Hardly; I should not attribute any difference to that. Sometimes if you are wintering near valleys, the currents there would be very great, greater perhaps than in the open sea.

5880. Was not the "Assistance" a teak-built ship; and do you consider such ship the most suited for arctic service?—I think she was admirably adapted for the service, from this circumstance, she was so very strong, and especially her decks were much drier than if they had been of fir. I think both our ships and tenders were most admirably adapted for the service, and if I went out again I should prefer the ship and tender I had to anything you could provide me with now. I regard the advantage of the space of a ship without a steam engine on board as a great boon for health; steam power was available from the tender when it was wanted, and we had the benefit in winter quarters of a ship, without being deprived of the space for engines and boilers.

5881. Was the space allotted to each man on the living deck of the "Assistance" greater than that of other arctic ships of which you have had experience?—Looking at the "Alert" and the "Discovery," I think we had more space for our men than those

ships had for theirs; then, as you are aware, we had more space than the "Resolute" had. Our lower deck for the men was more spacious than the "Resolute's."

5882. Did you consider the ventilation of your ship as perfect as could be?—I consider we rendered it so, taking into consideration the way she was fitted for arctic service.

5883. In the ventilation of an arctic ship, could you suggest any means by which the outer air might be admitted and warmed around a Sylvester stove before it circulated through the ship?—That would be a very desirable object to attain, no doubt; but as to the technical details, I could not furnish you with those.

5884. Do you remember what the range of the ages of the men of the "Assistance" was?—About 28 or 30.

5885. What standard would you establish in the choice of men for arctic service, with regard to age, height, and weight?—I suppose the standard for age would be from 25 to 30. As to height, of course, if you were entering men, you would take into account very much the build of a man; sometimes a man of 5 ft. 6 in. would be as powerful and better suited than a man of 6 ft. I suppose, as an average, about 5 ft. 10 in. would be the proper height.

5886. Was there anything special in the clothing of your men?—There was the special equipment of arctic clothing, which was distributed to the men gratis; it was made of what they call box-cloth. Then we gave them, if you remember, the fur caps, and the Welsh wig, and comforters, and mittens, and boot-hose, and they had the large sea-boots, and the cloth boots; but I suppose expeditions subsequent to that have even improved on what we had. What I used myself, next my person, was chamois leather.

5887. Have you had an opportunity of seeing the clothing of the men of the late expedition, and have you formed any opinion of its superiority over box-cloth or sealskin?—I saw it exhibited at Portsmouth. If I went out again I should prefer a nice comfortable sealskin overall jacket to what I wore then, the box-cloth jacket.

5888. In your sixty days journey over the ice, what was its state generally?—In crossing Barrow Strait, from Griffith's Island to Cape Walker, which is about 60 miles, it was generally good travelling; the depth of snow was sometimes 6 or 8 inches. When we got to Cape Walker, and in some parts of the coast of Prince of Wales' Land, it was very rough.

5889. Do you think that this rough ice in any way resembled the descriptions you have heard of the ice met with by the sledge parties of the late arctic expedition?—There were some portions of the ice which were broken up, and piled up about Cape Walker, which gives me some idea of what they met with.

5890. Did your men undergo very much fatigue?—Sometimes.

5891. I believe you mentioned that your party suffered from snow-blindness?—Yes, some of them very severely. On two or three occasions we were delayed from the snow-blindness, but I understand expeditions since that have been provided with goggles, or some protection to the eyes, which we had not. I recommended goggles being supplied in future expeditions. We prepared some crape veils, which did not last; they were blown away, as they hampered the men's faces.

5892. So that the snow blindness arose from want of proper precautions?—Yes, we were not provided with any protection. Osborn suffered very much.

5893. I believe you state that you suffered much from frost-bite during the expedition to Ommanney Bay?—Yes; you are fully aware how they returned to the ship. The worst case was one man who lost four toes. I think that arose principally from inexperience at starting. Some of them wore leather boots against orders.

5894. Did any suffer amputation on returning to the ship?—Yes, one of my men had his great toe amputated.

5895. You mentioned the instance of one man

having suffered from what you called rheumatism. Did you remark any signs of debility, swollen feet, or sore gums amongst the men of your party?—No.

5896. On your return to the ship, you say, the men were in good health, and you likewise mention having given rest to them for two days. Was that simply a precaution, so as to enable them to recover from their previous fatigue?—On reaching the ship we allowed them two days off duty just to recover themselves and refresh themselves, and we gave them a special diet, with medical comforts; they had the best food that we had on board, and a warm bath.

5897. What was your own personal state of health on your return from Ommanney Bay?—I was as well as when I left the ship, or better. I was in the most perfect state of health, better, I think, than when I left.

5898. On your return to England, you state that your ship's company was in good and sound health; to what do you attribute the immunity from disease which your ship's company enjoyed?—I think the routine, the internal arrangements, the ventilation, the excellency of the provisions we were supplied with, good discipline, a sufficient amount of work, and, during the winter season, a large share of amusement and recreation. I believe there never was a healthier set of people. Many of my followers complimented me by saying that it was the happiest time they had in the service.

5899. I understand you to attach value to lime juice as an antiscorbutic; have you made it a duty to order the issue of lime juice to every ship under your command?—Always. I should wish to mention this: of course, I have had several opportunities of being on particular service, when in command of the White Sea squadron, during the war, 1854, and other places. I have always made a point at sea of giving the men of the first and middle watches a hot drink of tea or cocoa and a bite of biscuit about five bells in the first and middle watches. I did that in the White Sea, and also in the arctic expeditions, whenever I have had the power of a commanding officer to do so. When I was in the White Sea, I asked the French what antiscorbutic they adopted there, and they told me that every morning watch they gave each of the men a piece of raw potato and a petit verre de cognac.

5900. I believe you were stationed for a long period on the coast of Syria, at the termination of the operations on that coast?—Yes; a long time; 15 months, when commanding the "Vesuvius."

5901. And it was difficult to procure fresh vegetables; was not lime juice given with great advantage?—Yes.

5902. Do you remember whether your ship's company suffered from any scorbutic symptoms at that time?—I cannot say. I should wish to observe that, in the White Sea expedition, where we left England in May, and did not return till the end of September, the whole of that time we were on the resources that we had with us, and we had very little food but the ship's allowance of provisions; coming home the surgeon did mention that there were a few symptoms with regard to the men's gums, and that sort of thing, which began to show themselves; but, of course, we were not provided with the amount of antiscorbutics and luxuries with which an arctic expedition is, although it really was almost an arctic expedition; we went through very severe weather, the men were confined to their ships, and they had not the means of taking exercise that an arctic expedition has, to get out on the ice and walk about.

5903. You are now alluding to the White Sea expedition?—Yes.

5904. Am I right in saying that you had some experience during the Irish famine?—Yes; I was employed two years there.

5905. Did you observe any case of scurvy?—I often think of it. I have often thought that a great deal of it must have been scurvy, from what I have seen since.

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5906. You have no decided opinion upon that question?—No; but there was lividness about their appearance, and the lips. I think in many cases there was a great deal of scurvy amongst the Irish people.

5907. In your sledge journeys, do you know whether the men gave preference to pemmican or to boiled pork, as I see in your scale that you had 6 oz. of boiled pork, and likewise 1 lb. of pemmican?—Yes. I remember we all got more or less tired of pemmican, and we could not consume the pound. We found the allowance more than we could consume, and they had such preference for pork, that a few days before coming back I increased the quantity of the pork, and reduced the pemmican. I see there is a note on this scale in my writing: "On return, having a surplus of provisions, pork was issued in lieu of pemmican." A few days before reaching the ship they got so tired of pemmican, and they liked the salt pork so much.

5908. Had your pemmican any herbs and currants in it?—Not currants; but I think there were herbs. I remember that the greatest care was taken in the preparation of it in the Victualling Yard at Portsmouth, under the immediate eye of Sir Edward Parry and Richardson. The very finest beef that could be procured was used.

5909. Can you describe the mode of preparation of this pemmican?—The beef was cut in slices, and slowly broiled on some special gridiron, with some very nutritious kind of lard, I think it was.

5910. What is your opinion of rum in arctic service?—I should issue the same quantity again as we did in our expedition. I am not an advocate for reducing it, unless people had been brought up to temperance habits when they left England; but, I think, to start on a sledge party after being accustomed to drink a gill of rum every day, and then reduce it on leaving the ship to drag sledges, would be fatal. I occasionally issued an extra allowance to the gill, and I am quite sure that the sociality of it, and the refreshment it gave them, was a very great spur to further exertion.

5911. Did you ever issue rum during the mid-day meal?—Always; that is to say, for the luncheon at midnight.

5912. Did your men work better after they had taken their spirits than before?—Well, you see, they had worked perhaps three hours before, and, of course, it refreshed them, and they went off again in good spirits. After three or four hours dragging, of course it was refreshing.

5913. It has been given in evidence that rum, when taken at the mid-day meal, produces a degree of debility?—It was not the case with my men. I think it is the proper time to take it, decidedly; all looked forward to it with the greatest avidity.

5914. Did you ever give tea in the middle of the day?—No; after tenting.

5915. (*Dr. Fraser.*) Did I hear you correctly to say that in the pemmican that you used you under-

stand herbs were contained?—Yes; to the best of my recollection I think there were.

5916. Can you recollect what herbs?—No; but I am sure you could get the most accurate description how it was prepared. It was done under the superintendence of Parry and Richardson, in the Victualling Yard, Gosport, in the year 1850, and the master attendant of the yard took a great interest in the thing being prepared. I think you would get the most accurate accounts of it from the officers of the victualling department of that day.

5917. (*The Chairman.*) What was the general character of the ice over which your journeys were performed?—On my own journey between Griffiths' Island and Cape Walker, when we had to cross Barrow Straits, the floe was generally level. There were one or two occasions when there was a disruption of the floe, and the heaping up of hummocks, and occasionally a drag of a one, two, three, and a haul to get them over the hummocks; but in crossing that ice we averaged about 10 or 11 miles a day. Sometimes there was a great deal of snow, six or eight inches deep, and on reaching Cape Walker, and along the coast there, where it was broken up against the shore, it was very hummocky and rough travelling.

5918. Have you read the reports of the sledge journeys performed by the late expedition, and how do they compare in point of difficulty with those performed by you, first, as regards the land journeys; and secondly, as to that over the ice to the north?—I have not read the detailed reports of the sledge journeys. I have not seen them yet. I have merely read the report of Captain Nares, which has been made public. The nature of the ice for travelling, of course, was of a much more formidable and difficult nature than that which we had to contend with. I could have remained out longer than the 60 days. You must bear this in mind, I had this before me, the fear of the breaking up of the ice of Barrow Straits, by which I should have been cut off from the ship, and large open cracks were taking place when I returned; we had some difficulty in getting across them. I observe they had a lower temperature in the recent expedition than we had, but we suffered very much on the Cape Walker journey from the gales of wind, I think more than any party, according to the reports. On one occasion I know we were forty-eight hours lying in our bags in the tent, and the snow accumulating round the tent to a considerable height. I think that was the most trying part, being confined to the tent so long a time. As regards the journeys, I think we had more gales of wind to contend with than they had. From the conversation which I have had with Lieutenant Aldrich, I consider he made some very wonderful travelling, especially over some level land, as I understood from him. It appears that they seem to have suffered more in one respect than we did, that was a softer snow; they seem to complain more of soft snow and wet than we did when sledging.

The witness withdrew.

CAPTAIN HENRY W. FEILDEN, R.A., *examined.*

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—
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5919. (*The Chairman.*) On what day did you join the "Alert," and in what capacity?—I joined on the 27th of May, 1875, prior to her departure from Portsmouth, and as Naturalist.

5920. Did you belong to her until she was paid off?—Yes

5921. Enumerate the sledge journeys in which you were personally engaged?—I was absent from the ship about fifty days in all, but they were only short journeys, the longest not more than fourteen days from the ship; in fact, they were more excursions than extended sledge journeys.

5922. (*Admiral Sir R. Collinson.*) In the course of the winter which you spent on board the "Alert," will you tell the Committee how the lower deck was ventilated, and what particular circumstances con-

nected with the ventilation you think could be improved?—It is a subject to which I did not give any very particular personal attention, as the ventilation of the ship was entirely out of my line of duty.

5923. Did you suffer much from fetid air?—No; I think the air of our wardroom was wonderfully good.

5924. Did you suffer much from condensation?—In certain parts of the ship there was a great deal of condensation in out of the way corners where it was colder, and of course the vapour in the heated air condensed.

5925. Had you any drip in your cabin in the beams above you?—Plenty.

5926. Did you suffer at night from its dropping upon you?—We put up blankets over our heads, at

least I did in my cabin, a blanket to catch the water, and then had it wrung out.

5927. Does it occur to you how that might be prevented?—No; it is beyond one altogether to entirely prevent condensation.

5928. You had a special diet in the wardroom that was different from the men's; can you tell the Committee in what speciality it differed from theirs?—We had a small allowance of wine, which they had not on the lower deck, and we had some sardines, jams, and potted meats; but in the main part of our diet we had exactly the same as on the lower deck.

5929. Then there was no material difference in the quantity of food consumed by the officers and by the men?—You mean, as I understand, the difference of actual food eaten by individuals. On board of the ship I had not any means of knowing. At least, a comparative stranger like myself could not tell, more than by asking the men sometimes in an evening at school time, and during the winter they would say to me they did not feel very hungry, and they could not eat their preserved meat.

5930. Was it from deficiency of quantity or sameness of diet?—There was ample food. I fancy that their appetites were not so good.

5931. Is it your opinion that the appetite would have been improved by the addition of sauces and such like stimulants?—I should think so. I carved for the wardroom mess the whole time, and I made a note in my journal that when the moon was up all my messmates ate much better than when the moon was down during the winter.

5932. (*Admiral Inglefield.*) That was occurring once every month during the winter?—Yes.

5933. For how long a time, about a week; for how long was it that their appetites were better?—During the time that the moon was at and near the full. We were so for a week at a time. The fact was, that they could take better exercise.

5934. (*Admiral Sir R. Collinson.*) The exercise that was taken during the period that the moon was above the horizon was greater than it was at other periods?—I think it was.

5935. And it is to that that you attribute the increased appetite?—Yes, it is.

5936. Your absence from the ship was not beyond 14 days, I see, at any time?—I left the ship on one occasion, on the 11th of May; returned on the 24th of May; started on the 25th, and returned on the 7th of June; so I was away 28 days, with one day on board the ship.

5937. And when you were away on these expeditions did you take lime juice with you?—Yes, all but the first time; that was from the 24th of April to the 30th, seven days, when the temperature was low.

5938. Did you take your lime juice always, on board the "Alert"?—Most regularly.

5939. On principle, or because you liked it?—For both reasons. I should always have been glad to get more, if I could have got it.

5940. Your diet, while absent from the ship, was similar to that used by the sledge parties on the distant journeys?—I believe it was precisely the same.

5941. With the exception that you always took lime juice?—Yes.

5942. Had you any symptom of scurvy?—I had some slight symptoms when I returned in July.

5943. Can you give the Committee any reason why, as you were taking your lime juice regularly, these symptoms of scurvy occurred in your case?—I do not know, unless it was pulling at a sledge, and doing hard work. I did some rather hard work.

5944. Had you the dogs with you?—Yes, most of the time the dogs; and on the last journey I and Lieutenant Parr were pulling a satellite sledge; we were away shooting.

5945. At that period the snow had become soft?—Yes; and one had to wade over the knees through the water, sometimes up to one's waist, dragging through slush.

5946. And the severe exercise or labour contributed,

you think, to your having this slight attack?—Yes, certainly. Capt. H. W. Feilden, R.A.

5947. Did it last long after you got back to the ship?—No, not very long.

5948. To what do you attribute your rapid cure?—To rest, and good diet.

5949. (*Admiral Inglefield.*) You have acquainted the Committee that you drank your own lime juice with satisfaction, and would have drunk more; what was the quantity that was issued to you?—We had an ounce a-day, I believe, but on coming back from our journeys we were allowed double quantity, and when we knew that we had to return south, there was practically little difficulty in getting as much as one wanted to drink. If one had asked permission from the surgeon, he would have recommended more.

5950. Do you feel satisfied that all the men in the ship drank their full allowance during the winter months?—Certainly, they could not have escaped, for they drank their lime juice from the tub immediately after morning prayers, in the presence of an officer.

5951. But the Committee have been informed that when an extra issue was given, either previous to or returning from a journey, they were allowed to carry a portion of that extra issue to their messes; do you think that then they drank it?—I cannot actually, from my own observation, say that they drank it, but from what the men told me, and the way they seemed to like their lime juice, I have every reason to suppose that they did.

5952. Then I gather from you that lime juice was looked forward to with satisfaction by the men, and that it was regularly drunk, and in fact more would have been consumed if the opportunity had been given?—Yes, they certainly liked it very much.

5953. And it was not issued on the long sledge journeys?—I understand that it was not; but personally I cannot say.

5954. Do you see any difficulty in the way of its being issued on the long sledge journeys?—There is the question of its freezing.

5955. But if it could be prepared in any manner, such as in capsules or in lozenges, would there then be any difficulty; and do you not from your own experience consider that it would be advisable that it should be sent?—I should say, certainly. I think all experience shows that it is a most valuable anti-scorbutic.

5956. When you went on a sledge journey, did you carry medical instructions with you as to scorbutic symptoms and the means of meeting them?—The officer in command of the sledge had the medical instructions; of course I was under his command, under his guidance, and did not require a copy; but, to the best of my recollection, there was no reference to scurvy in the medical instructions.

5957. Was it not a subject of common conversation during the winter months, the appearance of scurvy, and the treatment of it?—No, I think not.

5958. Did the officers and men work in the same manner; I think you said that you and Lieutenant Parr took a satellite sledge between you?—Yes; we had no man with us.

5959. Then you took the whole onus of that sledge upon yourself?—Yes.

5960. You were away upon a shooting journey?—Yes.

5961. Do you give any decided preference to tea or rum for sledging?—There is no question about it, that any person would take tea in preference to rum, if one were obliged to be given up entirely.

5962. Which do you consider is best for travelling upon?—Tea.

5963. If tea, and rum are taken as part of a sledge diet, at what time would you issue the tea, and at what time would you issue the rum?—Provided you must have your rum, before going to your bag is the only time it would be useful, I think.

5964. And not disadvantageous?—During the time you are working I should think it is distinctly disadvantageous to have rum.

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5965. Have you formed any opinion as to the proper age of men upon these expeditions, from your own experience; I mean which men appeared to stand the rigour of an arctic climate best?—The working men were nearly all about the same age.

5966. But there were ice masters and officers who were older?—Captain Nares and myself, and Dr. Colan, I suppose, were about the oldest men in the "Alert."

5967. Did you find that your constitutions were less able to withstand the work?—I should think so at that age; a man near 40 cannot do the work of a young fellow of 27 or 28; he is not as active, and will not pick up again as soon.

5968. You are speaking simply of the physical work and not the mental work?—I did not include mental work.

5969. But when we speak of officers being above a certain age, their experience would not be sufficient if they were very young men?—Certainly not.

5970. And therefore while officers are not required to work, to have them so young as the men would not be suitable for such service, from want of experience; but for vigorous work, what is the maximum and minimum age you would fix from your own experience?—I should say the age we had them on board the ship.

5971. Then, in fact, the ages of the men on board the ship in which you served were, in your estimation, a very proper standard?—Yes, I think so.

5972. Have you formed any opinion as to the cause of the outbreak of scurvy upon the last arctic expedition, comparing that, as you naturally have, with those of previous voyages?—The greater absence of the sun may, perhaps, have had something to do with it.

5973. The length of darkness you mean?—Yes; but the severity of the outbreak is a puzzle to me.

5974. Do you see any way in which mustard and cress might have been grown to a greater extent than it was raised on board your ship?—No; I do not think there was any means. But with glass frames on land a large quantity might be produced in July.

5975. Is there anything that occurs to you with regard to the subject of this enquiry that you can suggest?—One of my companions was Frederick, the Esquimaux, and he suffered from scurvy rather badly, which showed that there was no immunity on the part of the Greenlanders.

5976. Did he employ any special remedies of his own, native remedies?—No; but he said, when he got back to Disco that he would get the root of the "Qvan" (*Angelica officinalis*) to eat (it grows tolerably abundantly there, and they make it into a kind of preserve, and they look upon it as a great antiscorbutic), and that would put him all right.

5977. Then you did not find angelica in the north?—No; we left it behind several degrees.

5978. It does not grow to the north of Disco?—It does not grow to the north of the 78th parallel, certainly.

5979. Then the Greenlanders' notions from his knowledge of the symptoms were, that some vegetable must be taken as a remedy?—Yes; that was his idea.

5980. And his proposal was not sorrel or scurvy-grass, but angelica?—Yes.

5981. (*Dr. Fraser.*) With the exceptions that you have stated, your sledge parties did not extend over any length of time, I think?—No.

5982. They were very short?—Comparatively short.

5983. Had you generally dog-sledges or man-sledges?—Always dogs, but the men had to work with the dogs too.

5984. In your longest expeditions they were dog-sledges?—Yes.

5985. Was it because you had dogs that you were able to carry lime juice?—No, I do not think so. It was on account of the temperature; we were able to use it without any difficulty of thawing it.

5986. Those expeditions in which you carried lime juice were commanded by Lieutenant May, were they not?—May and Egerton.

5987. How many expeditions were there in which you carried it?—With Egerton from the 11th of May to the 24th, and with Lieutenant May from the 25th of May to the 7th of June; and I carried it with Lieutenant Parr from the 19th of June to the 26th, and from the 11th of July to the 17th of July again with Lieutenant Parr.

5988. Then you have not carried it in all your expeditions?—All with the exception of six days?—I think.

5989. Can you again tell me what the date of the six days was?—From the 24th of April to the 29th. I am not quite sure, without looking at my journal, whether we did not have lime juice even then.

5990. But you did not use it?—Without looking at my journal I can hardly remember, but I do not think we did use it during those six days.

5991. But the temperature would be very low on the 24th April?—It was, I think, about -20° .

5992. Upon all the other occasions the lime juice was not frozen?—No.

5993. What ration did you use in the sledging expeditions?—One ounce.

5994. The full ration of board ship?—Yes, I think we did, to the best of my belief.

5995. Were you the only person attacked with scurvy during the sledging expeditions which you yourself accompanied?—My symptoms were so slight, that I hardly called them an attack. I was never on the sick list for them, but the Esquimaux certainly had a rather bad attack of scurvy; but, as for the others, I do not know about them.

5996. In which expedition did you suffer?—I had some slight symptoms when I returned to the ship, but I was able to do my work the whole time, so that I can hardly say that I suffered.

5997. That was in the last expedition, was it?—Yes, the date when I returned to the ship about the 17th of July, I had a slight touch of the disease.

5998. It did not interfere with your work during the sledging?—No, it did not.

5999. What was it that you did notice?—Stiffness in the back, sinews, and behind the knee joints, a little difficulty getting in and out of one's bunk; when one once got in, one did not care for getting up again very soon, and a whiteness about the edge of the gums, and a slight bleeding from the gums.

6000. Were you very feeble?—No; I dragged a good load up to the last minute of returning to the ship.

6001. And you were treated on board ship by a liberal allowance of food?—I treated myself.

6002. Did you increase your quantity of lime juice?—Yes, I drank my double allowance.

6003. You had no discolourations of the skin anywhere, had you?—No; I had a slight swelling round the ankle, which went away again after a few days' rest.

6004. Was it on this expedition that the Esquimaux suffered, or on a previous one?—On a previous one.

6005. Can you give me the date?—From the 11th of May to the 24th of May, and between the 24th of April and the 29th of April, he was suffering then; he was spitting blood then, when he was working hard, and his legs were swelled.

6006. Had he been in the expedition previous to the 24th of April?—Not on any sledging expedition.

6007. He came from board ship?—Yes.

6008. How had he been employed on board ship?—He had been employed with the other men to do regular work, bringing in ice for water, and doing jobs about the ship.

6009. I suppose he did not become ill on board ship, but during the sledging, on the 24th of April?—I do not think he was under treatment; he was not regularly on the sick list when he returned in April, I think, because he went out again on the 11th of May.

6010. He was certainly well when he left the ship on the 24th April, I presume?—I presume he was, so far as I know.

6011. But he did suffer between the 24th and the 29th April?—Yes.

6012. Was that one of the expeditions on which you carried lime juice?—No; I am not quite sure, but, as far as I remember, we did not have any lime juice on that expedition.

6013. That was the expedition in which his symptoms, as far as you know, commenced?—I cannot say when the symptoms commenced; he may have had them on board.

6014. You say as far as you know?—Of course, I do not know. I did not have him under my personal inspection on board.

6015. I understand you to say that, so far as you know, he was well when he left the ship on the 24th of April, and that he had some symptoms which you suspected might be those of scurvy, commencing between the 24th and the 29th of April?—I do not know whether he had not them before, because he was not under my supervision; as far as I know, he had not, but my opinion is not of any value upon that point.

6016. Was the Esquimaux's a bad case of scurvy?—No.

6017. I thought you said that he suffered severely afterwards?—I should not like to have been like him, but he was nothing like what some of the other men were, the really sick men; he had discolouration and swelling of the leg.

6018. You mean that it was a distinct and decided case, without being an extremely severe one?—Yes.

6019. I gather from what you have said that, with the temperature as you found it during May and until you left the arctic regions, there was no great obstacle to the use of lime juice, at any rate from May?—No, there was not.

6020. At what time of the day's work was it taken in your expeditions?—You must remember that we turned day into night. We generally took it after we had pitched the tent at the termination of the day's, or rather the night's work. We were thirsty, and were very glad to take the lime juice.

6021. Did you, in May, require to thaw water in order to mix with the lime juice?—Yes.

6022. So far as the opportunities which you have personally had of forming an opinion, the greater facility in using the lime juice in May consisted only in there being no necessity for thawing the lime juice itself?—And that on our short journeys we were better off for fuel than on the long sledging journeys.

6023. But it was not such an absolute necessity upon the short journeys as upon the long journeys?—I cannot say, but on short journeys there was no need to economise fuel, and lime juice could more easily be taken.

6024. You, in common with all the other officers, were perfectly satisfied with the quality of the provisions on board ship, were you not?—Perfectly. I heard it said that the salt meat was rather tough; but I have not had as much experience in salt junk as many of my messmates, and therefore I would not give an opinion upon that subject.

6025. I think we have had it in evidence that the full ration of salt meat was greatly reduced; that was so, was it not?—I believe it was.

6026. You noticed that the appetites of the men were not so good towards the end of the dark season as they were at the commencement?—The appetites of the officers I meant.

6027. There was a considerable difference, was there not, in the proportion of the number of officers who suffered from scurvy, contrasted with the men, in the "Alert"?—Yes; there were none of the officers on the sick list.

6028. Do you think, however, that, although there were none, or almost none, on the sick list, several might have been suffering from slight symptoms, such as you yourself have told us about in your case?—I should think it very likely that several were.

6029. Do you know that any were?—That is a medical question; but I think there were.

6030. Of whom probably the doctors knew nothing?—Yes; of whom the doctors knew nothing.

6031. Then the difference was not so great as it appears from the statistics with which we have been furnished?—It is my belief that the officers did not enjoy a total immunity from scurvy.

6032. I should like to ask you if you can add to the additional articles of food stated by you to be used by the officers, such substances as preserved shrimps and jams, as well as those you have already mentioned?—We had cheese, butter, and jams and sauces, which I believe the men did not have.

6033. You had not a large quantity of preserved fruits, as far as you can remember?—I think Captain Nares increased the allowance of preserved fruits for the men and for all of us equally.

6034. Were cranberries included amongst these preserved fruits?—No; only one member of the mess had a few pots of cranberries, in his private stock.

6035. What wines were generally used amongst the officers?—Port and sherry.

6036. Did they have no French wines?—No, except on two or three occasions we had champagne, kept in reserve, for special anniversaries.

6037. Do you think that the pemmican, generally speaking, was liked?—No, I do not think so.

6038. Do you think that the full allowance was eaten on the sledge expeditions?—I cannot answer for that; I was not on a long journey where I could tell.

6039. Did you use pemmican in your journeys?—Yes.

6040. Did you consume your allowance?—Yes, I always ate my allowance, and on one or two occasions I have eaten more.

6041. I understand that the potatoes were generally cooked with the pemmican?—Yes.

6042. Had you the same quantity of potatoes as we find in the ration which is printed?—I believe so.

6043. You know that that ration was 2 oz.?—Yes, we had a very good allowance.

6044. And that was mixed with the pemmican?—Yes.

6045. Then if any of the men did not eat their full allowance of pemmican, they would not eat their full allowance of potatoes, I take it?—I am afraid that my opinion is not of much value. With the dog-sledges I only had one or two men with me, therefore I cannot tell you what the men did on the long sledge journeys.

6046. Did you generally succeed in obtaining good drinking water while sledging?—Yes.

6047. And on board the ship?—Yes.

6048. (*Dr. Donnet.*) In what part of your ship was your cabin situated?—It was the middle cabin in the wardroom on the port side.

6049. How was it warmed?—It was warmed by a stove in the wardroom; the heat of the wardroom heated my cabin.

6050. Was your cabin sufficiently warmed by this stove?—Fairly warm; in the winter time it was generally above freezing, above 32°.

6051. You speak, however, of great moisture in your cabin, and the precautions which you took to prevent it; do you think that the ventilation was sufficiently good?—Yes, the ventilation was very good. I had a little india-rubber tube running down from the bulls-eye, which I took out, and had the air in from the upper deck.

6052. But that was not during the winter months was it?—Yes, during the winter months.

6053. Did not the snow, which covered your deck, cover your bulls-eye likewise?—Yes; but I had an arrangement to remedy that. I removed the glass from the bulls-eye in my cabin roof, then took a small box and placed it on the upper deck over the bulls-eye, covered it with snow to the general level, and then made a small aperture through the snow covering, into a corresponding hole in the box; screwed a bit of metal piping into the bottom of the box which rested over the hole from which the glass had been removed, and finally attached to this pipe an india-

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rubber tube in my cabin, which became a down-take. So by opening or closing this india-rubber tubing the amount of outside air admitted to my cabin could be regulated to any extent.

6054. What amount of snow had you on the upper deck?—About 12 inches deep, I think.

6055. Did you find any great benefit from the system which you adopted for the purpose of ventilating the cabin?—I could get air in if I wanted it, and keep it out when I chose.

6056. But was it not cold?—Anything just below freezing is an advantage, because then you do not have so much drip.

6057. Was there any uptake in the ward-room?—Yes.

6058. And did the air from your cabin escape by this uptake?—Yes, it went through the door; the door being always open it would do so.

6059. You mentioned the Esquimaux as having formed part of your sledging party. What was his duty when with you; did he drag the sledge as the other men did?—No, he was managing the dogs and guiding the sledge.

6060. His work was simply that of driving a dog sledge?—Yes.

6061. You mentioned that he fell ill; will you describe the symptoms you witnessed?—He was lame, and short of breath.

6062. How many days was he out before those symptoms appeared?—The very first day we left the ship it was on him.

6063. Was he ill before he left the ship?—Not that I know of.

6064. Did he eat his allowance?—He was not a very big eater; he did not eat as much as I did.

6065. Can you remember what information he gave you of the means taken by the Esquimaux towards preserving their health, especially when engaged in sledging, hunting, or general work?—The only information of value that he gave me was how to eat snow; never to put snow into your mouth, but to take it and squeeze it in your hand a little, and then hold it in your hand and keep breathing through it like a respirator, until a quantity of ice has melted inside, and then you suck the water out of it, but not to put snow into the mouth; that is the only thing he taught me that I found of any value.

6066. Did you use this precaution?—Sometimes I did.

6067. And with any benefit?—Yes, certainly; we got a drink of water instead of eating dry snow.

6068. When you say you took the lime juice with gladness, did you consider the question of scurvy, and was the lime juice taken to ward off scurvy?—For both reasons, and because I liked it also, and because I looked upon it as a preventive of scurvy.

6069. With your present experience, what is your opinion of the value of lime juice as an antiscorbutic?—I should say it is most valuable.

6070. Was not mustard and cress grown on wet flannel in your ship?—It was grown on flannel, and also in boxes of soil. Dr. Colan took great pains in raising it.

6071. Was it grown in sufficient quantity to give a ration to the men?—Not in sufficient quantity for that. I should think. Now and again the officers got a little, but not as a daily ration.

6072. Among the many plants which you collected in your expedition, did any of them possess any antiscorbutic properties?—We got the mountain-sorrel; but I found very little scurvy-grass.

6073. Did you find any cranberries?—No; there were no cranberries.

6074. Have you ever had any opportunity of observing whether dandelion was an antiscorbutic?—No; the only dandelion up there (*taraxacum dens-leonis*), is so very scarce, that there would not have been enough to make a salad of. We found it between the 82nd and 83rd parallel, but in very limited quantity.

6075. Had proper precautions been taken, do you think it could have been cultivated in any quantity?—It could not have been cultivated in the first year, because you would have to get the seed.

6076. (*Admiral Inglefield.*) Is it a perennial plant?—Yes. You would have to wait to collect the seed, and sow it the next year. The species that you are referring to is something different from that which grows in England.

6077. (*Dr. Donnet.*) Did you like the salt meat which was issued as part of the ration on board ship?—Yes, I liked it very well.

6078. Some complaint was made of it, and you mentioned that it was diminished in quantity: was it left behind entirely?—To the best of my knowledge the issue of salt beef was reduced during the winter by Captain Nares' orders, and, on the breaking out of the scurvy, or rather when many patients were under treatment for scurvy, I believe that the salt meat was stopped altogether, after the return of the sledging parties.

6079. Am I right in stating that you had great experience in the field during the late American war, under General Beauregard?—Some.

6080. Had you any opportunity to observe whether the soldiers under his command used antiscorbutics?—It is more than twelve years ago, but, to the best of my recollection, we had no issue of lime juice in any of the campaigns. We were never without vegetables when in the field.

6081. Do you know whether potatoes and molasses were taken by them?—They were always very glad to get potatoes.

6082. Was this a regular issue?—The molasses was an issue whenever it could be got.

6083. Have you any remembrance whether raw potatoes were taken?—No.

6084. Did you suffer from anything which, looking back with the light of your present experience, you consider to have been scurvy?—No.

6085. Can you furnish the Committee with a list of all the plants and seeds which might be taken out with an arctic expedition for the purpose of being sown, and which would be useful as antiscorbutics? Yes. (See Appendix No. 26.)

The witness withdrew.

REAR-ADMIRAL WILLIAM JOHN SAMUEL PULLEN, *examined.*

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6086. (*The Chairman.*) From the return which you have been good enough to furnish to the Committee, I observe that you made six sledge journeys between the 21st of March, 1853, and the 17th of April, 1854, from the "North Star," in latitude about 75° north, being absent 137 days from the ship, and during that time travelling 1,018 miles in weather generally severe but not in a very low temperature. I further observe that between the 19th of August and the 30th of September, 1852, you made three boat expeditions, being absent from your ship 33 days, and accomplishing a distance of 405 miles in weather generally very severe?—Yes.

6087. Between the 23rd of July, 1849, and the

9th of September, 1851, you conducted the extended boat expeditions detailed as follows: "I left the 'Plover' off Wainwright Inlet, latitude 70° 37' north, longitude 159° 54' west, at midnight of 25th July, 1849, to search the arctic coast with two whale boats eastward of the river Mackenzie, the mouth of which was reached on the 27th August, after traversing a distance of 692 miles in an ice encumbered sea. Then tracked up the river to winter quarters at Fort Simpson, reaching it on the 3rd October, 1849, after travelling a distance of 800 miles more, thus in all a distance of 1,492 geographical miles in 70 days from the time of leaving the ship. After wintering at Fort Simpson, we left it on the

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11th July, 1850, to search the coast eastward of mouth of river. Reached the arctic sea on 22nd, and Cape Bathurst, only a distance of 180 miles, not before the 10th August, and remained till the 15th, when the ice, still holding so close in on the shore, and so heavy that after many attempts could not get round it, therefore commenced return to winter quarters. Reached the mouth of Mackenzie on the 31st August, and Fort Simpson on the 5th October. On the following year, or 5th June, 1851, commenced return to England, and the ascent of Mackenzie with the boats of the fur traders on their route to York factory, which was reached on the 28th August. And on the 9th September, embarked with party in one of the Fur Company's ships in Hudson's Bay, and arrived in England in October, 1851. In the last search, we were 86 days in the boats, 39 of which was in the arctic sea, during which time we traversed 360 miles between Cape Bathurst and the mouth of the river, and 1,600 miles in its descent and ascent; in all 1,960 geographical miles. And from the time we entered the river on the 27th August, 1849, to the date of the return to Fort Simpson from Cape Bathurst, 5th October, 1850, the party had neither bread, vegetable, tea, sugar, nor spirits, in fact no farinaceous diet, living entirely on food to which they were quite unaccustomed. Yet with all the exposure, constant wetting, especially in the first voyage from ship, no symptoms of scurvy ever showed amongst the party?" —Yes; that is correct.

6088 (*Admiral Sir R. Collinson*). How many men had you in the boat expedition to the Mackenzie from Behring's Straits?—Fourteen, counting myself; seven in each boat.

6089. Your boats were six-oared whale boats, were they not?—No, five-oared whale boats; but I must tell you that I bought at Point Barrow an Esquimaux omiak, whose capacity for holding was very nearly equal to that of the whale boats. They were two dockyard whale boats.

6090. What was the diet which your men were upon on that boat expedition?—They were on preserved meats and pork and beef, just as we were on board the ship.

6091. In fact, the usual diet of Her Majesty's navy?—Yes, and we had preserved potatoes, vegetable and biscuit.

6092. You carried, I think you say, salt meat and salt pork, as well as preserved meat?—Yes.

6093. What did you take in lieu of flour to issue with the salt meat?—We had a little flour too.

6094. How did you cook the flour?—We made it up into pancakes, and all sorts of things in that way.

6095. In consequence of the quantity of fuel which you found?—Yes, we found quantities of fuel on shore.

6096. Had you any lime juice with you?—No.

6097. When you arrived at Fort Simpson, what diet were your boats' crews put upon?—On my way up the river, knowing the difficulty of feeding the extra people at Fort Simpson, I left the only officer that was with me and five men at Fort Macpherson; that was the first place that I visited. They told me there that they could keep the men throughout the winter. Then I proceeded on to Fort Simpson, about 800 miles further. There I remained, myself and the two marines that were with me, and the remainder of the party were sent on to the Great Slave Lake, which was 200 miles further inland. In consequence of the quantity of provisions which we had to throw overboard, coming along the coast in heavy gales of wind (and it was always rough in landing, generally a lee shore), our provisions were very much reduced. When I started in the boats I had 94 days' provisions for 14 men, besides 32 cases of pemmican, for *caché*, or *dépôt*. Then our equipment of arms and ammunition, spare clothing (though we had very little certainly of that) beside the 96 days' provisions. In the first gale of wind we were obliged to throw over whatever we could get hold of to relieve our boats. You may imagine what state our boats were in; but I was

obliged to do that or give up the expedition altogether. As Captain Kellett told me, "You must either do this, or give up the idea of getting on." I ran the risk, however, on an occasion like that; but I was obliged to throw the greater part of my bread overboard to relieve the boats; it was first at hand. The spirit was at the lower part of the boat, and I could not get at it to throw it overboard. By the time I got to the mouth of the river all my bread left was so damaged, and unfit for food, that I had none again from that time to October, 1850; and when we reached at Fort Simpson, with what we had thrown overboard, our 96 days' provisions were greatly reduced; in fact there was none of it left.

6098. The latter part of your boat voyage you were upon a reduced allowance of provisions?—No; we were provisioned then from the fur traders; we lived as the fur traders did.

6099. As you ascended the River Mackenzie before you came to the settlement of the Hudson's Bay Company, what provisions were you issuing to the men?—The same provisions that we had started with; we had sufficient to take us to Fort Simpson.

6100. Had you a full allowance of provisions there?—Yes.

6101. And upon your arrival at Fort Macpherson what was the condition or your men?—Those men that I left there; one of them was not very well when he left the ship, and I wanted to send him back when I sent back the large boats, but the man was so anxious to get on that I took him on. Owing to the constant exposure on the voyage, I thought it better to leave him at Fort Macpherson, as they said they could keep him there during the winter; but the other men were fairly well.

6102. Were there any scorbutic symptoms?—Not at all.

6103. On reaching Fort Macpherson what diet were they put upon?—Dried deer meat, and fish when it was got; in fact, we were living just as the traders did, who were dependent on the Indians for what they brought in to trade; got in their hunting.

6104. What allowance of bread were you able to give the men during the winter?—No bread at all.

6105. Will you say what allowance of meat and fish, on a general average, was issued to your boats' crews as a ration during the winter months?—The allowance of dried deer meat for a man was about 4 lbs. a-day, but they had nothing else. The dried deer meat was never thicker than half an inch, and just dark like my shoe. The bones were taken out, and the meat dried by the Indians in their camps. The allowance was about 4 lbs. of dried deer meat. When we got any fresh deer meat it was about 8 lbs. a-day. When we got any fish, the fish were a sort of bream, a very broad fish, and a very beautiful fish; when they were fresh, four fish was a man's daily allowance; that was about 8 lbs. or 10 lbs., I suppose. The pemmican, when we could get pemmican, that is pemmican made in the country, was about 2 lbs. a-day; when we could get any meal (barley-meal) with it, it was very good made into what the traders called "Rubaboo"; again when cooked in a frying-pan, "Recho," that too had flour or barley-meal. I wintered at Fort Simpson, and the fish that was brought to the fort came from the Great Slave Lake; they were caught there in August, and the supply was sent down to Fort Simpson in a frozen state. They were buried in the snow, and we used them as we wanted them. In the following May, when the thaw commenced, the fish were often rotten, or what is called short; not offensive so far as smell went; still we were obliged to eat them, we dared not throw them away till other supplies could be got; indeed it was necessity. The first winter I was at Fort Simpson with Mr. Rae, I lived with him, and we had only one fish-day in the week; the rest of the time was varied by deer's meat and sometimes bear's meat, and anything we could get. Mr. Rae's kindness was very great.

6106. Did you obtain any vegetable food during

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that period?—Not the first year, except in Mr. Rae's mess, some potatoes.

6107. As I understand you, the diet of yourself and the people who were with you then was almost exclusively a meat diet?—Yes, it was meat diet, with the one fish-day. In consequence of my being with Mr. Rae, the chief of the fur traders, who was supplied with about a bag of flour a year (or perhaps two, that I cannot vouch for; but I shared with Mr. Rae in any luxuries he had); I shared that with Mr. Rae. I was the only one that had anything of the sort; the men had nothing, or the officer that was with me.

6108. What did the men obtain to drink during this period?—Water.

6109. Then it was water for breakfast, water for dinner, and water for the evening meal?—Yes.

6110. No tea?—No. I might mention that we had other provisions as we shot them; for instance, when we got any geese or ducks, two wild geese was a man's allowance each day, but we had nothing else, or four ducks was a man's allowance. I believe that is about all the provisions that we had in the country. But on the following year, when proceeding homeward, we occasionally got fresh beef, and bread on arrival at Norway House, on Lake Winnipeg.

6111. When you proceeded to sea the following year, what was the general condition of your people? Very good.

6112. They thrived on what they had?—They gave no symptoms of sickness, they were all very anxious to go to the coast again. We were on our return to England, and arrived as far as the Great Slave Lake, when I received orders, if I thought proper, to go to the coast again. I thought there might be a chance of finding the lost voyagers, or news of them, and the men all volunteered to go; there was no hesitation whatever.

6113. What did you carry as provisions the second year in your boat voyage?—Chiefly dried meat and pemmican; and I took an Indian hunter with me, and a fisherman, just to get what I could by shooting and fishing.

6114. And the period you were absent from Fort Simpson, the second year, was how many days?—I left Fort Simpson on the 11th of July, 1850, and I returned to Fort Simpson on the 5th of October, 1850.

6115. Living the whole of that period on a meat diet?—Yes.

6116. When you got back in the autumn, what was the condition of your people?—Very good. I was the only one that was a little ailing. I do not know that I was exactly ill; the only thing was, that whenever we got any fresh meat, the cooking was either fried or boiled, and I fancied that I could make a good dinner; but I never could retain it on my stomach. I used to sit down and eat very well, but after eating a little I was always sick.

6117. Had you any pains in your joints?—No; I had a little diarrhoea, that was all.

6118. After that you returned to England?—Yes; I returned to England in 1851.

6119. (*Dr. Donnet.*) Had you no scurvy during that time?—No. The second year, when I returned to Fort Simpson, on the 5th of October, 1850, I found 18 bags of flour there, and about the same quantity of pemmican, which was distributed amongst the men for the winter. When I left the men at Fort Macpherson the first year, the officer in charge told me then that he could support these men during the winter. In February following, at Fort Simpson, I had a letter from the officer I had left with those men, dated Great Bear Lake; that was the first information I had of them. The person in charge of Fort Macpherson, when I arrived there, was not the head officer. When the head officer arrived at Fort Macpherson, he sent all my men on to endeavour to catch me. I was two days ahead of them, and the ice was fast in the river, and they got as far as Fort Norman, that is between Fort Good Hope and Fort

Simpson; they could get no farther; as they could not keep them at Fort Norman, they sent them to the Great Bear Lake to winter; and they wintered there in one of the ruins of Franklin's old fort that year, and they did not join me till about June, 1850 (I think it was, but I am not certain); at all events it was in time to go to the Slave Lake with me. They had to put the house to rights; there was a fisherman sent with them and a hunter, but they lived entirely on fish, which they were obliged to catch, setting the nets under five feet of ice, to catch these fish.

6120. (*Admiral Sir R. Collinson.*) So that one half of your people lived on a fish diet, and the other half principally on meat diet?—Meat and fish together; the pemmican was generally kept by the Hudson's Bay people for travelling.

6121. (*Dr. Fraser.*) In that journey of seventy days, in the first year I mean, I think you said you had to some extent the usual ship's diet?—Yes, preserved meats, you know; plenty of those, and vegetables.

6122. Were you liberally supplied with preserved vegetables?—Yes.

6123. Did that include potatoes?—Yes.

6124. You had a great deal of potato during those 70 days?—Yes.

6125. Can you tell me at all what ration of potato you used?—In the boats, of course, we knew that the provisions were to last us a certain time, and I think, from what I can recollect, that we had potatoes very nearly every day, mixing all up together, as a stew.

6126. As much as you could eat?—Yes, as much as we could eat: the men were never complaining.

6127. Then you arrived at Fort Simpson, and wintered there?—Yes.

6128. Was your stock of potatoes and other vegetables exhausted before that winter?—Yes; I was obliged to throw a great deal overboard to save our lives in a gale of wind.

6129. Did you carry any to Fort Simpson?—No.

6130. No vegetable food of any kind?—No. Mind, I was only myself and two men at Fort Simpson.

6131. Where were the other men?—On the Great Bear Lake, and the Great Slave Lake.

6132. You remained between the two parties?—Yes; in fact it was a matter of necessity. We could not find provisions without it. Of course, I was obliged to be guided by the Hudson's Bay people. Rae was there, and he was the man that so far arranged that, and did all he could for our benefit.

6133. And the dietary of the other two parties was very much the same as that of your own, was it?—No, they were worse off than I was; they had nothing but fish. It was only occasionally varied by dried meat, as well as pemmican. They generally keep the dried meat for travelling. On the Great Slave Lake they were at a fishing station, the Company's fishing station, the Big Island they call it; and sometimes, when the ice broke up, and we had to come to lines and hook, we got trout of 80 lbs.; they call them trout, there was all that creamy rich stuff between the flakes. In fact, it was so rich that I could not eat much of it. There was a trout handed in to my boat, when I was crossing the Great Slave Lake the second time, of about 80 lbs., caught with the cod line.

6134. And besides fish you had a great deal of meat, had you not?—No, not on the Great Slave Lake, nor at the Bear Lake; they had nothing but just what the hunter shot.

6135. It was game, was it?—Yes; occasionally he would perhaps get a deer. Always to every fort there is a hunter attached, one of the Indians, and in the spring of the year he is out, and whatever he can shoot, everything is religiously kept and brought back to the fort, and divided there, and every one gets his share of wild fowl when shot.

6136. Then I understand that at the Great Slave Lake the party subsisted chiefly on fish; at the Great Bear Lake on fish and game?—Yes.

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6137. And you yourself subsisted with your party chiefly on what you have told us?—Myself only; the men that were with me lived just as the Hudson's Bay people did. I was living in the fort with the officer. Rae was the officer then in charge; he was allowed, I think, about a bag of flour a year, or it might be two, I thought it very small, even for one person, and I got a share of that; it was not much, certainly. They occasionally grow potatoes, and we got a few of those potatoes. There was one piece of ground that they cultivated at Fort Simpson; for ten years they have been growing potatoes in it. This I learnt from the man who worked as gardener; and I have some faint recollection that barley was also grown there, using it occasionally as porridge. We were glad to get anything, we were dependent so greatly on the Indians for the meat only. The Indians bring in their food, and exchange it for whatever they require, powder and shot, and blankets, and all that sort of thing.

6138. At Fort Simpson the party consisted of yourself and two men?—Yes, that was the first year.

6139. And your diet was rather different from that of the two men, I think I understand?—Yes, the two men lived as the Hudson's Bay people lived, and I have given you what their allowance was, so far as I knew.

6140. A very large allowance?—Then the men had nothing else to eat.

6141. Were these three places stations belonging to the Company?—Yes.

6142. Where people were in the habit of living?—Fort Simpson was the head station of the Mackenzie River District. On the Great Slave Lake was their fishing station; but on the Great Bear Lake those were abandoned stations. The place that they lived at there was an old fort which Sir John Franklin had built.

6143. Fort Simpson and the Great Slave Station were constantly occupied, were they?—Yes; constantly.

6144. And scurvy was an unknown disease?—I do not think the men suffered at all there. Once only I got a complaint that they were not accustomed to the diet; and Mr. Rae remedied this in a measure, by directing meat occasionally to be issued them; but we had nothing else.

6145. But they constantly occupied these stations?—The Hudson's Bay people.

6146. Canadians; not natives?—Not the Indians, but the half-breeds. The officer in charge was either an Orkney man or a Scotchman. Rae was an Orkney man, I think, and Bell, I think, was a Scotchman; and Mr. Ross was a Scotchman. But all good men; Rae, a perfect gentleman.

6147. And they were able to cultivate the ground to some extent, you say?—There was a small patch of ground which they had at Fort Simpson. My idea was that they could have done a great deal more, but their object, of course, was to keep the country wild. Directly you cultivate you send all the furs away. There was never anything which you can call a supply for the whole fort.

6148. They grew potatoes chiefly, you say?—Yes, they have been growing potatoes there for ten years.

6149. No other vegetables?—No; a little barley there might have been growing. They did grow barley, now I recollect, and a few turnips.

6150. With the exception of these potatoes, you had no other vegetable food excepting barley and flour?—I got a little of the barley meal and a little of the flour, which was the allowance of the officer in charge of the fort. Rae was the chief factor, I think, and then comes the chief trader. The second year Bell, the chief trader, was in charge. Both these officers are known as having had to do with the arctic expedition, and the former was a great explorer. They were allowed a certain allowance; it was brought in in the summer, and it had to last them till the next year.

6151. Did you find you were able to eat larger quantities of fish and flesh than you were in the habit

previously of eating?—As far as I am concerned, I could not. A man that was with Sir G. Simpson on his memorable journey used to eat 20 lbs. a-day of meat.

6152. Were these hunters?—No; men of the fort. One man was with me the second time when I went down the coast; he was one of the boat steerers. I took two of the Company's men with me on the second voyage, a Scotchman and French Canadian, both fair eaters.

6153. Were they fishermen?—He was a fisherman; and he was a hunter too; they used all to make the best of their abilities.

6154. Was there no store of preserved vegetables in the fort or station?—No; we were entirely dependent upon the Indians for meat, what they brought in. They brought it in to trade with, and that was what we got; and out of that meat they used to make pemmican.

6155. Did the men generally eat the meat undercooked or over-cooked?—They used to have it pretty well cooked. I always used to establish my own servant as cook for my own party, when I got to the fort.

6156. There was no eating of raw meat, or partially cooked meat?—No, not where I was, I think, amongst the men.

6157. I think you said that the only drink you had was water?—All the men had. I got a little tea from Rae.

6158. You made no beer, spruce beer; for instance?—No, nothing of the sort.

6159. Did you use spirits at all?—We had none.

6160. Was there none stored in the station?—No. The second year I got a little in, but not sufficient for the men.

6161. And you were in very good health on this dietary, were you?—Yes, I was in very good health: we had no doctors with us. I do not think any of us ever took any medicine; in fact, we had none. Rae was and is a medical man, but I don't think we ever troubled him.

6162. You had no lime juice?—No lime juice. I took none from the ship. I always considered that the provision was so good that it was hardly needed; we had so much of the preserved meat and vegetables when we left the ship.

6163. But then you failed in the supply of vegetables, did you not?—Yes, but I could not calculate on our being so hard put to it.

6164. Have you ever been on any voyage or expedition in which you have had scurvy?—No.

6165. Or in which any of your men have had it?—No.

6166. You scarcely know what it is?—I know what it is. I have been travelling in Australia, where we were travelling without provisions for a long time; nothing but meat diet.

6167. This diet at Fort Simpson, and at the other two stations, appears to have been almost entirely a fish and meat diet?—Yes, for the men.

6168. Did the fish or the meat predominate?—I think that they were a longer time on the fish diet; mind I am speaking of the first year.

6169. In the spring of the following year did you go away from Fort Simpson?—Yes; in the spring of 1850 I went down on the coast again.

6170. What party accompanied you?—I had the same party, with the exception of two men.

6171. Do you mean to say those men who had been stationed during the winter at the two lakes, as well as those who were with you at Fort Simpson?—Yes, they all joined me in the spring; at least the men of the Great Slave Lake did not come to me, but the men of the Great Bear Lake came up to me; they knew I should pass through the Great Slave Lake on my way back to England, and I picked them up.

6172. Was there any change in the general dietary during this spring?—No; except that when we started to go down on the coast again, we had pemmican with us. Dried meat was the chief provision

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then, and we had some fresh deer meat which we found at Fort Good Hope on our way down the river.

6173. You had no vegetable food?—No; but I found on one of the islands off the coast in Liverpool Bay some mushrooms, which we made good use of.

6174. And the meat you used was generally, excepting of course the dried meat, well cooked?—Yes.

6175. Where was this pemmican made, do you know?—In England, that pemmican was made were two or three caches which I picked up, and some which came in for us.

6176. Was the meat in the pemmican mixed with any vegetables?—It was made in England, and I do not think it was. Some of the pemmican was made with currants and sugar, but we always preferred the pemmican without, just the plain pemmican.

6177. You were absent from the 11th of July, to the 5th of October?—Yes.

6178. And all the party enjoyed good health?—Yes, all; except that I had a little diarrhoea, and, after sitting down and eating a little, I would feel sick.

6179. Did the men appear to you to be strong?—Yes.

6180. Had they much hard work?—I think so. I never had such work in all my life. Our trip to Cape Bathurst was only a distance of 180 miles; and I got into the Arctic Ocean on the 22nd of July, and I did not get to Cape Bathurst until the 10th of August. It was in consequence of this heavy ice being so close in on the shore that I could not get round the cape, therefore had to return to winter quarters. We were dragging the boats over the ice constantly. The ice was so close on the shore that we could not get along without unloading them, and loading them up again.

6181. And at the end of that expedition the health was still perfectly good?—Yes, perfectly good.

6182. What was the number of the party?—The same as I had before; 17, including myself.

6183. (*Dr. Donnet.*) Was your expedition one in search of Sir John Franklin?—Yes.

6184. Did all the men of your boat expedition of the first year belong to the "Plover"?—Yes.

6185. They were all English?—All English sailors.

6186. No Canadians or Esquimaux?—No.

6187. Whilst your men were on the Great Bear and the Great Slave Lakes, I think you say that their food was almost confined to fish in the last instance, combined with beef in the former; for what period of time did these men live on this diet?—I arrived the first time the 3rd of October; they went on, on the 6th, and I do not think it was varied till I picked up again those on the Great Slave Lake in the following July or the end of June, it might have been; and on the Great Bear Lake, from the time I arrived at Fort Macpherson, the first time (I think it was about the 6th of September), they had nothing but fish, except occasional deer meat the hunter might have got, until they joined me at Fort Simpson in the following year. I think it was in June, 1850, that they joined me again.

6188. Can you say with any certainty that these men during this period used no vegetable food of any sort?—I am certain of that.

6189. Were there no vegetables grown on the shores of these lakes?—No, it is too cold.

6190. Of the meat and fish which you state these men were supplied with, which did they prefer?—I rather think they preferred the meat; sailors are great fish eaters, but when you get a long supply of it, you get tired of it.

6191. When the men had only fish for their diet did they complain of not being satisfied with the 10 lbs. they were supplied with?—The allowance of fish they had were four fish a-day. I should say they were about 10 or 12 lbs., but I am not certain as to that; the white fish they call them, and good fish they are when fresh. But the fish on Great Bear Lake were chiefly herrings.

6192. When you arrived at Fort York Factory, in Hudson's Bay, what state were your men in?—In good health.

6193. In other ships to which you have belonged in other parts of the world you have remarked that lime juice was always served out as an antiscorbutic after the ship had been at sea for 14 days?—In other parts of the world it is the custom of the service, after 14 days salt provisions to serve out lime juice.

6194. Do you know for what reason lime juice is thus served out in the navy?—As an antiscorbutic, after being so many days on salt provisions, we have lime juice issued.

6195. Do you think that it counteracts the effects of salt meat?—I think it does, I have no reason to think the contrary. I do not think I ever in my life met with scurvy.

6196. Have you ever heard of the Esquimaux having scurvy?—No. They never have any fresh vegetables, theirs is always a meat diet, they have seal and blubber, and all that sort of thing.

6197. Have you ever observed scurvy amongst the people of the Hudson's Bay Company?—No, not as far as my knowledge goes of the people that I was with.

6198. Had you any conversation with any of the Hudson's Bay Company people regarding scurvy, and the precautions to be taken against it?—No.

6199. What reason can you give for the immunity from scurvy of the Hudson's Bay Company people?—I do not know; I cannot give any reasons more than that they had plenty of work; they were never confined, never breathing a vitiated air, and the provision was fresh, you know. But doctors say it is not fresh meat alone without vegetables that will give freedom from scurvy.

6200. You have some experience in arctic navigation; do you consider lime juice a necessary article for ships employed in this service?—Yes; I think it is right that they should take it; but I do not think we ever issued it in my ship; the provisions were so good, and there was so much vegetable, I do not think I ever recollect the doctor recommending it.

6201. Have you formed any opinion about the causes of the outbreak of scurvy in the late expedition?—No; I have not. The only idea I had was that it might be from the possible confinement; perhaps the ships were shut up very much closer than our ships were, and they might have been from that long confinement breathing a vitiated air, so that they might have been predisposed to scurvy when they left the ship. That is the only reason I can give. They were shut up, you know, so very long a time, (of course they could not help it), closed up.

6202. Had they taken the lime juice with them, do you think that the outbreak would have occurred?—I hardly see how they could have taken lime juice; it would have been in such a state from being frozen, that the time that it would have taken up to thaw it, and all that sort of thing, would have involved a great loss; and the question is whether the lime juice would not have lost its property after thawing. We never had any lime juice in our travelling parties.

6203. (*Admiral Sir R. Collinson.*) How many winters did you pass at Beechey Island in the "North Star"?—1852, 1853, and the beginning of 1854. We came home in October, 1854.

6204. You spent two winters?—Two winters.

6205. What was your diet in the "North Star"; was it of the same character as that of other polar ships?—The same character as the other polar ships; the same as you had in your ship, I think.

6206. Have you seen the diet list of the last expedition?—No.

6207. I will put this into your hands (*handing it to the witness*), and just ask you to glance your eye over it, and see if that is of a similar character to the diet which you issued to your people on board the "North Star"?—Yes; as far as I recollect it is much about the same, except that we had not quite so much lime juice; there was very little lime juice, so far as I

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recollect, issued, because we considered the provisions were so good, so much vegetable.

6208. Did you issue a ration of lime juice on board the "North Star"?—Yes, occasionally, we issued lime juice.

6209. Was it drunk at the tub, or were the men allowed to take it to their messes?—At the tub; it was always mixed. We never took any lime juice travelling.

6210. I will come to the sledge journeys directly. I want now to go through the winter diet on board ship, and the health of the crews. At the end of the first winter, what was the condition of your people?—At the end of the year I think the condition was bad, but, mind you, not from scurvy. My ship was driven on shore by the ice on the 29th of September, and from that time till the 4th of December we were constantly working, first to try and get her off, and next to get her upright in a position for the winter. I think it was the 28th of September that we were driven on shore with a heavy south-east gale of wind. I was only riding at single anchor. I was just waiting for the ice to break to get into my winter position, and one of these gales came on. As far as ever we could see in Barrow Straits it was clear of ice, all the Bay was clear of ice. A strong breeze began, I suppose, about eight o'clock. The night was as clear as a bell. A little while after it came on to cloud. The ice came in with a south-east wind right into the Bay. It was full of ice in a very short time, and we were riding, as I say, at single anchor. The master was very anxious that we should let go another anchor; he had never been on the ice before; he came to me, and said we had better let go another anchor. I said, "It is no use; it will only lie on the ice alongside." "Well, sir, if the ship is lost, I dare say the first thing asked will be did you let go another anchor." And so we let it go, and it lay alongside. We began to drag, and were lying in seven fathoms of water; then she came to four and a half, and then she took the ground, and was thrown over on her broadside, and we were nearly thrown over; then I expected to see the ice going through the ship's bottom, or coming up over us, and covering us. Erebus Bay is an immense bay. Fortunately it was the top of high water spring tide. We could not see anything then; but an hour after the gale commenced, I conjectured that the bay was full of ice; at the head of the bay and all within us; that it helped to resist the pressure on the ship. We first of all commenced landing provisions, to endeavour to get her off, and from that time I worked till the middle of November, opening the ice out. As fast as I opened it out in the morning, in the evening we could walk on it, so that I had to give that up. Then I had to get the ship upright.

6211. Without going into more details, you say that your men were in consequence of this very much harassed by hard work?—Yes.

6212. Therefore, you had a considerable number on the sick list?—No; they were not on the sick list. I only had 41 men, and 11 of those were officers. You know what an old 28-gun ship was. And they were so done up, that it appeared to me that they did not like the idea of another winter; and when Captain Inglefield arrived with the "Phoenix," I exchanged with him nearly the whole of the crew.

6213. So that you had not the same men on board your vessel the second winter that you had the first?—No, with the exception of a few; there were a few that remained; and I did not get the ship off and afloat till the following June.

6214. At the end of the second winter had you any symptoms of scurvy?—No.

6215. What was the condition of your lower deck, was it well ventilated?—Yes. On the "North Star" we had the main deck and the lower deck; the main deck was our berth deck, and the lower deck was where we used to do work. My object was to keep the men employed as much as I possibly could during the winter. We always found something for them to

do, besides the reading and other instruction that went on.

6216. So that you found the lower deck a great comfort to you during the winter?—That is why I think a ship of that sort the very ship for an arctic expedition.

6217. Had you much dampness on the lower part of the upper deck overhead?—No, not the maindeck. We had a Sylvester stove in the main hold, and pipes went round the ship from that; they went aft round, and forward again to the stove; the galley was before that, and occasionally we had small stoves, hanging stoves, about the deck.

6218. So that you think your ventilation was particularly good, except when the vessel was on shore?—No, not all the time she was on shore; she was nine months on shore before I could get her off again. Directly the tide fell she went over on her broadside, then dampness ensued till I got her upright, when the stoves cleared it off, and I was obliged to build her up with ice to retain her in an upright position.

6219. You made some sledge journeys, I think?—Yes.

6220. Were they of any long duration?—My longest sledge journey was 35 days.

6221. And what diet did you put your men on for a sledge journey?—Just the same as we had on the ship (a little more perhaps of the preserved meat and pemmican), except that whenever the men went out we used to give them some of those sticks of chocolate and free tobacco.

6222. Had that chocolate milk with it?—No, with tin foil about it. We had chocolate besides with milk mixed; Moore's chocolate, I think it was.

6223. Did you carry lime juice with you on these sledge parties?—I never carried a drop of lime juice in any sledge party from my ship.

6224. And you mentioned that altogether during your sledge journey you were 137 days under canvas, and did 1,018 miles altogether?—Yes; sledge journeys only.

6225. And had you very severe work on those sledge journeys?—The first time I crossed Wellington Channel to go up to our rendezvous, I was sometimes only going one or two miles a day, the ice was so heavy.

6226. Had you to unload your sledge?—Yes.

6227. And it was very severe work?—Very severe work; and when I got into the land, about 54 miles from the ship, both my sledges broke down; then I had 79 miles before me.

6228. Have you any recollection of what the weights were which you were dragging?—The first time, on the 21st of March, I had 1,172 lbs. on the sledge; about 193½ lbs. for each man.

6229. (*Dr. Fraser*) On board the "North Star" you had a dietary, I think, nearly similar to that of the recent expedition, had you not?—Yes, much about the same, as far as I can recollect.

6230. And on your sledge parties, what diet did you take?—I will give you the equipment of one sledge.

"Weight on sledge when I started from Erebus and Terror Bay for Points Phillips and Cape Becher, in the Wellington and Queen's Channel:—

	lbs.
Sledges and sledge bottoms	137
Pikes and ropes, complete, tent and pegs	75
Buffalo robes, 4 in number	42
Blauket bags, 7	55
Macintosh cloth, teut bottoms	34
Ammunition, 2 muskets, smoke balls, rockets, &c.	120
1 Sundry bag, pickaxe, shovel, and axe, cooking apparatus	15
Medicine chest, sextant, artificial horizon, books, &c.	48
Pannikins, spoons, &c., haversack	8
Dead weights, constant	534

Rear-Ad. W. J. S. Pullen. 27 Jan., 1877.	“Provisions :	lbs.
	Pemmican	228
	1 case of skin, ditto	45
	Bacon	54½
	Dog's meat	104
	Bread, in 1 case and 3 black bags ..	250
	Flour and potatoes	68
	Grease	76
	Spirits of wine } for lamp for cooking {	16
	Rum	54
	Soups, Milk, chocolate, salt, pep- per, &c.	88
	Sugar and tea	15
		998½
	Constants	534
	Total	1,532½”

being provisions for thirty days for seven men, also for five dogs. Now, allowing 360 lbs. for the dogs, it would leave 1,172½ lbs. for the six men, or 193½ lbs. each.

6231. Can you remember the daily allowance of potatoes?—I cannot exactly recollect that.

6232. Did you carry lime juice?—No.

6233. The health of your men was always good, I think?—Always good.

6234. There was no suspicion of scurvy at all?—No.

6235. Was your dietary the same throughout your sledge parties?—Just about the same.

6236. No important variation?—No.

6237. (*The Chairman*.) What was the general character of the ice over which your sledge journeys were performed?—Very heavy, piled up; and we were often reduced to the one, two, three and a haul.

6238. Was it hummocky ice?—Yes; and, of course,

where the hummocks were piled up there was soft snow lying between.

6239. Have you read the reports of the sledge journeys performed by the late arctic expedition, and how do they compare in point of difficulty with those performed by you; first, as regards the land journeys, and, secondly, as to that over the ice to the north?—It appears that they were rather more severe than ours; the cold was very much against them.

6240. Do you consider that the labour was greater?—Yes; I think, generally speaking, the ice must have been heavier, from what I can judge from reading the accounts.

6241. In your sledge journeys were any of your men affected by scurvy, or by symptoms which you would now be disposed to consider scorbutic?—No.

6242. To what do you attribute their immunity from scurvy?—That is where I am puzzled. We never had any scurvy, and we had the same provisions, as far as I can judge; our spirits were the same, but it was very seldom that I took any spirits on the journey. I generally used, whenever I could get it, and there was time to melt the snow, to take tea.

6243. We have it in evidence that, on camping at night, the allowance of spirits was found very useful as a stimulus to enable the men to shift their gear and settle themselves for the night; what would your opinion be on that point?—I can only judge for myself. The men generally had their allowance of spirits in the day time; and they used, after changing their travelling dress, to get into their bags and light their pipes; and I never had any complaint; there appeared to be no want of spirits amongst them. I think I was the only one that suffered with snow-blindness and rheumatism. I was twice obliged to stop and get into my bag, the rheumatism was so bad; that was in the last journey that I took.

The witness withdrew.

Adjourned to Mouday next at 11 o'clock.

MONDAY, 29TH JANUARY, 1877.

PRESENT :

ADMIRAL SIR JAMES HOPE, G.C.B., in the Chair.

ADMIRAL SIR R. COLLINSON, K.C.B.

VICE-ADMIRAL E. A. INGLEFIELD, C.B., F.R.S.

JAMES J. L. DONNET, ESQ., M.D., R.N., Inspector-General of Hospitals and Fleets, R.N.

THOMAS R. FRASER, ESQ., M.D., F.R.S.E.

H. J. VANSITTART NEALE, ESQ., Secretary.

MR. RICHARD BAYLEY, Boatswain, R.N., *examined*.

Mr. R. Bayley,
Boatswain,
R.N.

29 Jan., 1877.

6244. (*The Chairman*.) You are at present boatswain of the “Fisgard”?—Yes.

6245. Enumerate the Arctic expeditions in which you were engaged?—The first one was in H.M.S. “North Star,” with Captain Saunders, in 1849, as captain of the foretop. The next was in H.M.S. “Assistance,” with Sir Edward Belcher, in the years 1852, 1853, and 1854.

6246. Enumerate the sledge journeys in which you were engaged?—The first was on the 22nd of March, 1853, from the winter quarters of the “Assistance” to lay down a depôt of provisions at Cape Lady Franklin for the spring travelling in July, returning to the ship in eight days; the next was from the 10th of April, 1853, to the 12th of July, 1853, in search of Sir John Franklin.

6247. Who was the officer who commanded the sledge party?—Commander George Henry Richards, the present Admiral Richards.

6248. Which was your next sledge journey?—

On the 22nd of February, 1854, with Admiral Richards, when we were absent 76 days.

6249. (*Admiral Sir R. Collinson*.) In the “North Star” did you pass the winter in the Arctic regions?—Yes, in Wolstenholme Sound.

6250. What was the state of the crew during that winter in the “North Star,” were they healthy?—Generally healthy.

6251. Had you any symptoms of scurvy?—Not to my knowledge.

6252. Was the lower deck warmed and ventilated?—We had to make stoves from some tar casks, we had nothing supplied for the purpose; we lived on the main deck.

6253. Do you know if you had the Sylvester stove?—No.

6254. I believe it was intended that you should return to England?—Yes.

6255. Instead of which you passed the winter there unexpectedly?—Yes.

6256. So far as you can remember, there were no symptoms of scurvy?—There were no symptoms of scurvy to my recollection.

6257. Did you take your lime juice during that period regularly?—Yes.

6258. How was it served out?—Generally speaking as it is used in the service.

6259. Was it drank at the tub, or carried down into the messes?—Carried down into our messes.

6260. You then joined the "Assistance," and passed two winters, I think, on board that vessel?—Yes. I may say that during the time we were in winter quarters in the "North Star," we were six upon four.

6261. I thought that you had plenty of provisions?—Yes, we had, but not of our own; they were supposed to be Sir James Ross's, we landed them for him.

6262. Had that any effect, do you think, on the health of the ship's crew?—We had plenty of exercise, and I can say that I personally never enjoyed better health in my life.

6263. You would have liked to have had something more?—Yes, indeed.

6264. In the "Assistance" you were upon full allowance, I believe, throughout the whole of the winter?—Yes.

6265. Was it sufficient?—Yes, I had no complaint, and I do not think any complaint was made.

6266. Did you save any provisions?—We used to make our own bread, and leave our biscuit behind.

6267. You never left any meat behind?—No.

6268. Do you recollect what proportion of meat you got?—I could not say for a fact.

6269. But it was alternately preserved meat and salt meat and bacon?—Yes.

6270. Had you preserved potatoes issued to you?—Yes.

6271. How frequently?—As far as I can recollect, twice a week.

6272. Can you remember the quantity?—No, I cannot.

6273. What was the allowance of lime juice given to you on board the "Assistance"?—The usual quantity, I think half a pint per man per day when mixed with water.

6274. And that was drunk in the messes?—Yes.

6275. From your experience, do you think everybody took it?—I think not—as for myself, personally, I do not think I took it more than four or five times during the winter.

6276. With respect to the degree of comfort on board the "North Star" and the "Assistance," which was the pleasantest vessel to pass the winter?—The "Assistance."

6277. Was that owing to the Sylvester stove, or to the greater accommodation on the lower deck?—Owing to both.

6278. What means had you for washing your clothes in the winter?—The mainhold was cleared out, and we washed in the mainhold the first winter.

6279. Did you all wash at the same time?—No.

6280. How was it arranged?—By watches, one watch each day. The second winter we had a wash-house built on the upper deck under the housing.

6281. Had you much moisture on the lower deck of the "Assistance" during that winter?—No. On one or two occasions I recollect we had.

6282. Did it drop into your hammock at night?—No, not so much as that.

6283. In the second winter we understand some improvement was made in the hatchways?—Yes.

6284. Will you describe what that improvement was?—The hatches were built over with wood from the foremast, including the main hatchway right along; the forepart formed the washhouse, and also we kept our boats in board "in gallowses," bottom upwards, and canvassed over head, which formed a second awning.

6285. And you think that added to your comfort?—Yes.

6286. With respect to your sledge journey you had bacon, pemmican, and potatoes, had you not?—Yes.

6287. Which did you like best, the bacon or the pemmican?—The pemmican.

6288. What quantity of pemmican had you, do you know?—It differed; we could not regulate it. We used to cut it with an axe, and pick it out in pieces, and put it in as we required. Sometimes we had a little more than others. I do not think we had an opportunity of weighing it, but we cut it from the bulk.

6289. Did you usually finish what you cooked?—Yes.

6290. Do you think it was enough?—Yes; I had no complaint to find with it.

6291. Do you think that the potatoes were sufficient?—Yes.

6292. Did you carry any lime juice?—No.

6293. You returned to the vessel without any signs of scurvy?—Yes.

6294. Was anybody ill at all during the journey?—One or two had a little snow-blindness. I lost my sight myself for a day or two, but that was all.

6295. But no man was necessitated to fall out from the drag-ropes except for snow-blindness?—That is all. Everyone did his duty at the sledge at the drag-ropes.

6296. (*Admiral Inglefield*). You say that you did not drink your lime juice but twice or three times during the winter months on board the "Assistance." Why did not you drink it?—From not liking it; not caring for it particularly.

6297. Then there was nothing compulsory about your taking the lime juice?—No.

6298. It was issued to the men, and if they liked to throw it overboard they might do so?—They might have done so, but I do not think it was done so. It was that way that they could have done it if they liked.

6299. Did you get much in the way of sorrel and scurvy-grass on the shore at Wolstenholme Sound?—Yes; we used to pipe hands to grass occasionally.

6300. Did you grow any mustard and cress?—Yes.

6301. Then this formed during the winter a sort of fresh vegetable?—Yes.

6302. Had you many sacks of potatoes on board?—No; only Edwards's preserved potatoes.

6303. What sort of exercise did the men take?—As a rule, they used an iceberg for water, and, as a rule, we used to take part of a watch to go and drag the ice down to the ship, and also we had a circle round the ship a mile and a quarter in circumference, and also from the ship to that we had a walk, and we used to keep ourselves employed in keeping it clear of the snow.

6304. Were there not some Esquimaux in your neighbourhood?—Yes.

6305. Did they often come to your ship?—Not during the winter, except on one occasion, when they brought one on board frost-bitten, who died on board.

6306. What did he die of?—He had been watching a seal-hole for seals, and got both his feet frost-bitten, and they brought him on board for our doctor's inspection, and they kept him on board, and he was on board, I think, about three months, and it turned to mortification, and he died.

6307. Were they amputated?—Yes.

6308. Did you ever see any signs of scurvy amongst the Esquimaux there?—No.

6309. Have you formed any opinion as to the best age for men to engage in arctic expeditions; at what age they seem to stand the cold better?—I should think from 26 to 30.

6310. But not younger?—No, not younger.

Mr. R. Bayley,
Boatswain,
R.N.

29 Jan., 1877.

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R.N.
29 Jan., 1877.

6311. Was there much dampness on your lower deck in the "North Star," when you wintered at Wolstenholme Sound?—Yes.

6312. How did you get rid of it?—We used to wipe it with cloths, and then it used to freeze—in fact, we used to have to scrape all the iron bolts every morning. We had nothing but the same things as an ordinary man-of-war, not having been prepared for wintering out there.

6313. And the ship was frozen in for how many months?—Eleven, from September to the following August.

6314. Then you had none of the usual provisions supplied to ships that spend the winter in the Arctic regions, such as preserved meats?—Yes, we had, but it was those preserved meats which some years ago were very bad. It was in 10 lb. tins.

6315. The same as were supplied to Sir John Franklin, do you mean?—Yes.

6316. You had some of those on board—did you find them bad when you opened them?—Very bad.

6317. In fact, were they of the same batch as were supplied to Sir John Franklin, namely, Goldner's?—Yes.

6318. And were those cans of preserved meats often found to be filled with entrails and offal?—Yes, I have complained of them myself, on several occasions I found it so.

6319. Notwithstanding all these disadvantages, your men were healthy?—Yes.

6320. There were no signs of scurvy?—Not to my recollection.

6321. And the ship returned to England with a healthy crew?—Yes.

6322. The "North Star," wintered in latitude 76° 30' north?—Yes.

6323. Did you ever make any expeditions to the Eider Duck Islands, or were they too far?—They were too far.

6324. I dare say you have read the accounts, and know pretty well the circumstances under which the people of the late expedition were equipped, where they went, the length of time, and the service that they had to perform; has there occurred to you any reason why the scurvy broke out so severely amongst them?—The only thing that I can think of myself, if I must say it, is, that I think they were too much nursed up during the winter; that is rather a bold answer, I am afraid.

6325. You mean that the men were not hardened off enough?—Not exercised enough.

6326. Upon what authority do you say that; have you seen any of the men and asked them what the routine was, and so forth?—No, I have not seen any of the men; no more than I have thought by experience, that men not knocking about on the deck or the lower deck occasionally, would not be half the men to do the duty as those that were exercised on the upper deck.

6327. (*Dr. Fraser.*) You had no scurvy on the "North Star" in 1849?—Not to my recollection.

6328. And the health of the men was very good generally?—Yes.

6329. Was it in the "North Star" that the provisions were bad you have just told us?—Yes.

6330. What meat had you besides the preserved meat which turned out so badly?—The old salt beef and pork.

6331. Can you recollect what vegetables you had; you have told us of potatoes, what else had you?—Rice.

6332. Had you any green vegetables; had you preserved cabbage, or carrots, or parsnips, or any thing of that sort?—I think not. I do not recollect it.

6333. Had you not some carrots?—I do not recollect.

6334. Lime juice, however, was issued as a ration?—Yes.

6335. And you had half-a-pint of it diluted daily, or an ounce a day?—Yes, an ounce a day.

6336. That is, an ounce diluted to half-a-pint?—Yes, I think that is it.

6337. You wintered for 11 months in the "North Star"; how long did the darkness last, as far as you can remember?—I think about 90 days.

6338. Had you been exercised a great deal during that winter?—Yes.

6339. How many hours were you exercised out of the twenty-four, do you think?—Outside the ship, if it was possible, two hours in the forenoon, and two hours in the afternoon, four hours a day.

6340. Sometimes more and sometimes less, I suppose?—Yes, sometimes more and sometimes less, according to the weather.

6341. Then you did not drink your lime juice, excepting on one or two occasions?—On several occasions, two or three.

6342. What became of it if you did not drink it?—My messmates drank it.

6343. Some of your messmates drank it; were they fond of it?—Yes.

6344. Were there many like you who did not care for it, do you think, or were you quite exceptional?—I cannot speak of any one besides myself.

6345. Do you rather think that you were exceptional in that case?—I do not recollect any one else.

6346. As a rule, so far as you can remember, the men liked it?—Yes.

6347. In fact, you had no difficulty in disposing of what you did not take?—No.

6348. Who was the doctor in the "North Star" on that expedition?—Dr. Rae.

6349. Was the diet very much the same in the "Assistance"?—No, we had more preserved provisions there.

6350. And they turned out better, I suppose?—Yes, and we had preserved vegetables too, of all kinds.

6351. Did you get a ration of preserved vegetables every day?—Yes, I think so, but I will not be certain.

6352. You think that you got preserved vegetables every day?—I think so.

6353. Did you get potatoes every day?—I do not remember; I think not.

6354. You got lime juice every day, I presume?—Yes.

6355. Was it the full ration?—Yes.

6356. Neither in the "North Star" nor in the "Assistance" was the lime juice served at the tub, was it?—Yes, it was served in the ordinary way.

6357. I mean, it was not seen to be drunk by the men?—Each mess took their own from the tub.

6358. Was it drunk under supervision, or was it left to the men?—It was left to the men.

6359. Do you think that the men generally drank it in the "Assistance"?—I think so.

6360. You do not remember any cases in which they did not; had you then become fond of it yourself?—No, I never cared for it.

6361. Then you did not drink it in the "Assistance" either?—I cannot say but what I drank it, but it was on very few occasions. I did not drink it regularly.

6362. You always found some one who was willing to take it from you?—Yes, I never looked at it; it was in the mess, and it was gone.

6363. Had you any game in the "North Star" during the winter?—Yes, but it was very little—a few birds and a few hares, which I think were principally given to those who were on the sick list.

6364. It was never issued as a ration?—No, it was never sufficient for that.

6365. I need not ask you if you had any fish?—No, we had not.

6366. Had you much game in the "Assistance"?—No.

6367. Not more than when you were with the

"North Star," even if so much?—I do not think we had any in the "Assistance." I do not remember that anything but a fox and a bear were shot; we had no musk oxen or deer there.

6368. Did you eat the fox and the bear?—No.

6369. Were there any sledge parties from the "North Star"?—No.

6370. You yourself accompanied three from the "Assistance"?—Yes.

6371. The first being only a short one of eight days?—Yes.

6372. The second was the longest, I think?—Yes, 94 days.

6373. And the third 76 days?—Yes.

6374. Did you carry lime juice upon any of those occasions?—No.

6375. You carried pemmican and bacon?—Yes.

6376. And preserved vegetables?—Not on the sledge party; we had no preserved vegetables on the sledge.

6377. Had you potatoes?—Yes, we had potatoes on the sledge.

6378. Then you had vegetable food on the sledge journeys?—We had pemmican, bacon, potatoes and biscuit. I think we had one mess of deer, which we shot coming back from Melville Island on one occasion.

6379. I suppose you could not forget if you had had potatoes?—I remember we had them.

6380. Was the pemmican sweet pemmican, do you remember?—I think we had three sorts; we had some with currants, and sweet, and plain.

6381. Had you some with currants on all three expeditions?—Yes, in the travelling expeditions we had.

6382. Did you carry most of it with currants, or most of it of some other kind?—If I recollect rightly it was most preferred with currants, but I will not be certain on that point.

6383. You did not get any sorrel, or mustard or cress, did you, in the sledging expeditions?—No.

6384. Were those man sledges or dog sledges?—Man sledges.

6385. Was the work very hard?—Yes, at first going off, very particularly so, because we had five depôt sledges went away with us, so that we fed from them, and we always had the heaviest load ourselves to drag.

6386. Was the ground very difficult?—Very heavy indeed; in fact, we had to lift the sledge bodily on some occasions, we could not draw it.

6387. Did you go continuously on each of those journeys, or did you have a rest of a day or so at any time?—They were few and far between, if we did. I do not remember it. On one or two occasions I remember being snowed in, and not being able to get on.

6388. Then you did not go every day without an interval through the whole of those expeditions?—No.

6389. You always had rests now and then of some days?—On very few occasions, to the best of my recollection. I think, if I recollect rightly, on one occasion, on coming back from one journey our clothes were wet, and I think we had a day's spell to get dry.

6390. Then you did always work right on?—Yes, I think so. We changed our mode of travelling twice, that is to say, we travelled as it were by night instead of day.

6391. You carried rum, I suppose?—Yes.

6392. Was that liked by the men?—It was as a rule.

6393. Did all take it?—Yes.

6394. Do you think that it was beneficial?—Yes, I think so.

6395. Was it taken at the end of the day's journey, or in the halt?—In the lunch halt.

6396. You did not carry any condensed milk with you, I presume, on those journeys?—No.

6397. And the men remained in good health, did they, throughout all the sledging expeditions?—Yes.

6398. And all quite well?—So well that we were able to do our duty.

6399. Still some were not so well as when they started?—No.

6400. We will take the first journey, which was one of eight days. You had one man-sledge, I suppose?—We had six altogether.

6401. How many men?—I think one was a ten-man sledge, and the other seven.

6402. What load did you drag?—I think, in the first place, it was about 240 lbs., and also we had a boat, which we took over to Cape Lady Franklin.

6403. You did not notice that the men became weak during that expedition in any way?—No.

6404. They were not feeble?—No.

6405. Did they eat their food throughout well?—Yes.

6406. Did they eat better at first, or towards the end of the journey; or did you notice any difference?—No.

6407. And they returned to the ship in quite as good health as when they started on their journey, without an exception?—Yes.

6408. With no frost-bite?—Not so far as I remember.

6409. With reference to the second journey, which was the longest, had you several sledges, or how many?—Five, besides our own.

6410. Were the loads about the same as those which you have just named in connection with the first journey?—Yes, we had five sledges.

6411. Have you anything to say respecting the health of the men on this second expedition?—I think, when we got on board we were a little weaker than we were at starting, and we had a couple of days' rest before we were able to work. I think the Captain gave up a couple of days' rest before we turned to again, but it was only two days.

6412. That was given, was it, to the whole party?—Yes, we had a great deal of travelling through sludge, the latter part of the time.

6413. Did you make the same distance at the end of the journey returning home, as you did starting, do you think, or did the weakness of the men that you have just alluded to prevent your getting on so quickly?—I think we got on as well during the latter part of the time, because our sledges were lighter.

6414. Did any of the men fall out?—No.

6415. Were they examined by the doctor when they came back?—Yes.

6416. You heard of no suspicion of scurvy?—None.

6417. On the third journey was the health as good?—We broke down, I think, at first starting; if I remember rightly the thermometer was down to 41° below zero. I think we had to lay by once on board the "North Star" in Beechey Island.

6418. On the third journey, how many sledges and men had you?—Two sledges, a 10-man sledge and a 7-man sledge.

6419. In the first week you were all knocked up?—From the 22nd of February to the 29th we experienced it very severely, we could not eat or drink or sleep. On one occasion the thermometer was down to 43° below zero.

6420. How many days after starting?—On the 24th of February the rum was frozen, and we could not cut the bacon with an axe.

6421. Then although your appetites were good, you were not able to satisfy them?—No. The next morning we left the sledges on the ice and walked into the "North Star."

6422. Was that because you could not get any food?—Because we could not take it.

6423. What were you suffering from, do you remember?—Intense cold in the inside, I think, at the time.

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6424. You, yourself, were suffering?—Yes.

6425. Can you recollect what you felt?—A numbing sensation in my inside, if I recollect right.

6426. Had you any pain?—I could not describe my feelings now.

6427. Then you went on board the “North Star,” how long did you remain there?—We appeared to be all right again the next day, but we remained there six days or a week before we started again.

6428. You were under Dr. Toms, I suppose, then?—I did not know the name of the doctor on board the “North Star” then.

6429. Did any of the men go under his care?—Not to my knowledge. I believe I did not myself.

6430. After this rest of six days you resumed your journey?—Yes.

6431. And did you complete it without any further breakdown?—Yes, I do not recollect any breakdown after that.

6432. And you recollect that the men continued in good health after that until the end of that journey?—Yes.

6433. None of the men fell out?—No.

6434. And their appetites remained good?—Yes.

6435. And they appeared to do their work well?—Yes, very well.

6436. Did you get lime juice when you were on board the “North Star” at that time?—I could not answer that question, I do not recollect. I have no doubt we did.

6437. You have never had scurvy yourself, have you?—No.

6438. (*Dr. Donnet.*) The object of the “North Star” was simply a store ship, or aiding ship to Sir James Ross’s expedition, was it not?—Yes.

6439. You say you were six men upon four men’s allowance whilst at Wolstenholme Sound; did you not get any game there?—No.

6440. Had you any Esquimaux living in the vicinity of the winter quarters of the “North Star”?—A short distance from us.

6441. You mentioned one case of frost-bite, the subject of which died on board after amputation. Did not several Esquimaux die just about the time you broke out of the ice?—I do not recollect that they did.

6442. At what distance were these Esquimaux living from you?—About five or six miles, I think.

6443. In the Sound itself?—Yes, in the Sound.

6444. Did they not bring any reindeer, moss, or scurvy grass, or sorrel to you?—No.

6445. Or any article of game?—No.

6446. Did you sleep in a hammock whilst in the “Assistance”?—Yes.

6447. Was it a hammock like those supplied to the navy generally?—Yes.

6448. Will you tell the Committee of what your bedding consisted?—Two blankets, and the usual sailor’s bed, a mattress of hair.

6449. Then you slept between the blankets?—Yes.

6450. Were all the other hammocks like yours?—That may be, I could not answer that. There may have been some little addition on their own private account. Perhaps they might have a quilt additional.

6451. In what part of the ship were you berthed?—Abreast the fore hatchway.

6452. Did you complain of the cold during the night?—No, not in the “Assistance.”

6453. Was the lower deck of the “Assistance” kept comfortably warm during the night?—Yes.

6454. Was the berthing of the men changed?—Not to my knowledge.

6455. Each man consequently kept his berth during the whole of the time?—Yes.

6456. Were you refreshed with the sleep which you were able to obtain in your berth as a rule?—Yes, as a rule I was.

6457. Do you think that all the men on the lower deck were able to get sleep enough to refresh them?—Yes.

6458. How did you feel, as a rule, on getting up in the morning?—Very well in health, able for anything, able to do my duty.

6459. Do you know whether the ship’s crew enjoyed their sleep at night?—I never heard any complaints.

6460. Was the atmosphere of your deck on board the “Assistance” moist?—I think the first winter it was a little.

6461. Was it greater than you found it on board the “North Star”?—No.

6462. Do you think that the difference was owing to the difference of the build of the ship, the “Assistance” being of teak, and the “North Star” not?—I could not say for that.

6463. Or was it due to the better accommodation of the “Assistance”?—We had the deck covered with snow in the “Assistance,” but we had not in the “North Star.”

6464. What was the depth of the snow on board the “Assistance”?—If I recollect right, I think it was a foot deep.

6465. Do you think that that added greatly to the comfort of the men on the living deck?—I do.

6466. Did the drip distress you much?—No, not in the “Assistance.”

6467. Your hammocks were never made wet, then, by the drip?—No.

6468. Was there ever any complaint made of the moisture by the ship’s crew generally of the “Assistance”?—I do not think there was a general complaint. I cannot say that there was.

6469. Do you know whether cold air was admitted to the living deck during the time the men were asleep?—Not unless any person opened the door over the hatchways.

6470. Were your hatchways fitted with any hoods or covering?—They were built in with wood, with a door or entrance to go up and down.

6471. Have you ever heard the men complain of the cold air when it was admitted into the living deck?—No, not particularly so; I do not remember.

6472. Were the hammocks stowed in a dry place?—Yes.

6473. Were you sufficiently well clothed during the winter months; will you describe the different articles of dress which you wore when obliged to go on the floe?—Box cloth trousers and jacket, sealskin cap, and snow boots; that was all, I think.

6474. What difference did you make in your dress when you came on board, and when you went to your mess?—We had to take our jacket off and shake it, and hang it where we could close to the Sylvester funnel along the deck.

6475. Do you think that the condition of the lower deck and your mess place were as good as they could be made in an arctic ship?—I never heard any complaints of our lower deck, our lower deck was very comfortable.

6476. Was your routine on board the “Assistance” somewhat similar to the routine of H.M.S. “Alert,” which I now show you (*handing a paper to the witness*)?—I can scarcely recollect; I recollect we used to go to divisions every morning at 10 o’clock.

6477. At what hour did you breakfast?—Seven o’clock, I think, but I will not be certain.

6478. What did your breakfast consist of?—Usually of cocoa, soft bread, and the remains of our meat that we did not eat at the other meals; we used to eat it at breakfast at times, but not always, and bacon occasionally.

6479. When did you issue the lime juice?—Between 11 and 12 in the forenoon.

6480. At what hour did you dine?—Twelve.

6481. Did you consider the diet supplied to the ship’s crew good?—I do not recollect any general complaint being made.

6482. Did you ever hear the men regret the want of any article of diet?—No, not as a rule; I cannot say that I did; our salt beef was killed and cured in Deptford expressly before we left England, it was not like what we had in the "North Star."

6483. Was the salt meat as much liked as the preserved meat?—As a general rule, I think it was.

6484. Did you in your own person feel a want or craving for any particular article of diet which you had not on board ship?—No.

6485. You had amusements provided for you, had you not?—Very little.

6486. Had you no theatres?—We had one or two, I think, got up by Captain Richards, but there was nothing very particular about it.

6487. What was the kind of amusement that you had in the winter months?—Two theatres; we used to go to school, and there were lectures given by Sir Edward Belcher and Admiral Richards, occasionally on Monday evenings, on all kinds of subjects.

6488. How did the men generally amuse themselves during the time they were on the living deck, or when they had no very particular duty to do?—Dominoes, cards, and chequers as a rule, generally speaking, and making or mending clothes.

6489. Did you ever, among yourselves, speak of scurvy and of the possible occurrence of scurvy among you?—It was discussed on several occasions, I remember.

6490. Have you any remembrance of what was said at the time?—No, I could not say.

6491. In your sledge journeys you travelled by night and slept by day; was this owing to the difficulty and inability to get sleep from the great cold at night?—Yes, and from the sun occasionally being so brilliant on the snow in the daytime that we thought it better to sleep by day and travel by night, as that it would not affect the eyes so much; I think that was the idea.

6492. Was the snow and ice very difficult to travel over?—On several occasions it was.

6493. What was the nature of this ice?—Ice broken up and formed into hummocks.

6494. You say that on your third journey your men lost their appetites after the second day; was this owing to the intense cold, or can you give any other reason?—No other reason than that.

6495. You mention not having taken your lime juice; had you any personal objection to it?—Nothing more than that I did not like it, that was all. I had no taste for it.

6496. Did it disagree with you?—Not that I know of, but I never took a liking to it; but even on the coast of Africa, in the hot weather, I never cared for the lime juice.

6497. Was the food of the sledge parties relished by the men?—Yes.

6498. Did they find it sufficient in quantity?—I never had any reason to think that they did not.

6499. You say that you took your rum at luncheon; did the men work as well after it as they did before?—Yes.

6500. Did you take tea with you in your sledge party?—Yes.

6501. And did the men like it?—Yes; I was always ready for my own basin of tea when it was ready, after we pitched the tent.

6502. Do you think that the men preferred it to rum?—I could not say that.

6503. Did you all enjoy your tobacco?—Yes.

6504. (*The Chairman.*) You stated that you had made three sledge journeys with Admiral Richards, two of which were in the spring of 1853, and one in that of 1854, on the whole being absent 179 days, and travelling 1,567 miles?—Yes.

6505. What was the general character of the ice over which your journeys were performed?—The ice in the first journey was generally good. On several occasions we had to pick the hummock down

and make a road for ourselves, but only on a few occasions.

6506. On the second journey, which was 936 miles in 94 days, what was the character of the ice?—We had on several occasions hummocky ice, and had to pick the ice down to make roads for the sledge to pass, and also we travelled over Melville Island from one side to the other, where we had very heavy work, occasionally having to let our sledge down stern first in the ravines.

6507. On the third sledge journey, which was in the spring of 1854, what kind of ice did you meet with?—Very rough ice.

6508. What was the general character of the snow which you encountered in crossing Melville Island?—The snow on Melville Island was generally soft, the foot would sink in it to a depth of from a foot to three feet.

6509. On the ice, what was the character of the snow generally?—In the first part of the time it was a hard surface, but in the latter part of the travelling expeditions, such as the latter part of June, owing to the sun, the snow would be soft, and the sledges would sink into it.

6510. What depth was it in the snow when it was soft and sludgy?—Our sledges would sink in up to the bottom of the sledge—the runners would sink in occasionally altogether.

6511. (*Admiral Sir R. Collinson.*) You slept abreast of the fore hatchway, I think you say?—Yes, in the "Assistance."

6512. Had you any screen?—No.

6513. Were you on the side that the Sylvester pipe was, at the head of your hammock, or were you on the opposite side of the deck?—The Sylvester pipe did not come before the fore part of the fore hatchway, it extended in the after part of the fore hatchway.

6514. Then you had not the advantage of being alongside the Sylvester stove?—No.

6515. (*Admiral Inglefield.*) In the "North Star," at Wolstenholme Sound, you had only a warming apparatus on your lower deck, which was rigged up impromptu, on account of the ship being detained by the winter?—That was all.

6516. Then you had no other heating apparatus on the lower deck belonging to the ship?—No.

6517. Did what you had keep the lower deck pretty warm?—We had two stoves made from tar casks that we used occasionally to keep it up, as far as the captain would allow us coal, and, if I recollect rightly, he issued 60 lbs. a day for that purpose.

6518. Did that keep the deck pretty warm?—When once made hot, it would keep warm some time.

6519. But still you were not nearly so comfortable as on board the "Assistance"?—No.

6520. Do you know what amount of coal was burned on the lower deck of the "Assistance" in order to keep it warm?—I could not say. I particularly recollect that I was more comfortable there than in the "North Star."

6521. I presume it was a good deal more than 60 lbs.?—I could not say.

6522. (*Dr. Donnet.*) Although you say that lime juice was not taken by you, what is your opinion of the use of lime juice in the service generally?—Very good, I should think it, though I can speak personally that I do not suppose I drank more than a gallon in the whole of my lifetime in the service.

6523. Do you know what the reason is for giving lime juice in the service?—To prevent the men from getting scurvy; I have always understood so.

6524. (*The Chairman.*) We have had it in evidence that a great deal of care was taken on board the "Assistance" in previously training the men for their sledge work. Was that so?—Yes.

6525. Would you describe what was done for that purpose?—I recollect that we were sent out to walk four or five miles a day; also we were set to dragging stones over a hill to build cairns with in the winter time. Also we drilled at

Mr. R. Bayley, Boatswain, R.N. pitching the tents on several occasions, and packing and repacking the sledges.

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6527. What was the distance that you dragged those stones?—From the foot of the hills to the top of them, principally for building cairns, and by the time we got them there, I suppose it would be quite half a mile, the course that we had to take to get them there.

The witness withdrew.

MR. JOSEPH ORGAN, *examined.*

Mr. J. Organ. 6529. (*The Chairman.*) Enumerate the arctic expeditions in which you were engaged?—The "Enterprise" was the first one, from 1848 to 1849; then the "Resolute," from 1850 to 1851, where I was Ice Quartermaster of the "Pioneer"; then the "Assistance," from 1852 to 1854, in which ship also I was borne as Ice-quartermaster of the "Pioneer."

6530. Enumerate the sledge journeys on which you were employed, stating the officer who commanded, and in what capacity you acted?—I was first with a travelling party under Sir James Ross; I think at that time we were absent only 10 days; the distance I could not say. Then I was on many short journeys from the "Resolute," but I could not name the number of days. Then from the "Assistance," I was 96 days under the late Admiral Osborn. Then I was captain of the sledge; the distance, I believe, was some 1,200 or 1,300 miles. Then in the spring of 1854, I travelled under Admiral Richards; it was only a short journey, but we were travelling from the 26th of March, I think, till about the 18th of August, one place and the other, laying dépôts out.

6531. (*Admiral Sir R. Collinson.*) You have passed four winters in the arctic regions?—Yes.

6532. The first winter was on board the "Enterprise," at Port Leopold?—Yes.

6533. Will you describe the condition of the "Enterprise's" lower deck during the winter, as far as ventilation and moisture are concerned?—The lower deck was very damp and cold; every day men had to be employed washing the moisture off the beams of the lower deck.

6534. What steps were taken to ventilate it?—Doors were thrown open.

6535. Did you use the Sylvester stove?—Yes.

6536. And notwithstanding the use of the Sylvester stove, the lower deck was cold and damp?—Frequently there was ice on the deck.

6537. What was your allowance of provisions during that winter?—I think it was three-quarters of a pound of salt meat, salt pork, and salt beef, and we were allowed a pound of biscuits two days a week; and the remainder of the time, that is to say, five days, flour.

6538. Had you sufficient to eat?—No.

6539. Was the preserved meat good?—Very bad.

6540. I believe at the end of the winter, some of the men on board the "Enterprise" were attacked with scurvy?—I never heard of such a case.

6541. Do you know whether anybody on board the "Enterprise" had scurvy?—Never to my recollection.

6542. Had you many sick?—Several.

6543. When you came home, were any sent to the hospital?—Yes, but I do not know what their cases were.

6544. Was the lime juice regularly issued on board the "Enterprise"?—Every day.

6545. And how was it drunk, was it drunk at the tub by each man, or was it taken to the messes?—Taken to the messes and served out to the mess.

6528. We have it in evidence, that on camping at night the men found their allowance of rum very useful as a stimulant to enable them to take off their wet foot-gear, to pitch their tents and to make their other arrangements for camping; have you any recollection on that point?—Yes, I can recollect on many occasions, Admiral Richards has asked if the men would like a glass of grog, after the sledge stopped, while we pitched our tent, and got everything all ready. I cannot say that it was absolutely necessary, but I can say that it was done on several occasions, and was very agreeable and useful.

6546. Did you drink your allowance?—I was almost a teetotaller; I was a great hand for lime juice; I drank all I could get.

6547. Do you think that the men generally took their lime juice?—Yes.

6548. Were there any that did not take it?—I do not think that I knew of any one that did not take his lime juice.

6549. Now the next vessel that you joined was the "Resolute"?—Yes.

6550. Will you inform the Committee which, in your opinion, was the most comfortable ship of the two to pass the winter in?—The "Resolute," by far.

6551. In what way?—As to the ventilation, provisions, and every comfort that could be had on board a ship.

6552. Had you harder work in the "Resolute" or in the "Enterprise"?—The "Enterprise."

6553. What was the hard work in the "Enterprise"?—Continually dragging ballast off from the shore, to form the canal for the ship for the following spring.

6554. That is to say, you laid gravel on the top of the ice, under the impression that it would melt, and enable you to get out from Port Leopold quicker, instead of sawing it?—Yes.

6555. And this was very hard labour?—Yes.

6556. How long were you employed daily?—From about nine in the forenoon, to about three in the afternoon, that is deducting the dinner time.

6557. Though you returned to the ship for your meals, do you think that the duty thus performed by you in carrying out this ballast, was greater than the sledge journeys, either of the "Resolute" or of the "Assistance"?—No, the work was not harder than it was in the travelling parties. I am only speaking now of the work just round about the ship.

6558. Now to compare the "Assistance" with the "Resolute," which vessel had the most comfortable accommodation?—Well, I think they were both about alike; one was as good as the other.

6559. And were the arrangements on board the "Assistance" similar to those on board the "Resolute"?—Yes; there was every comfort given on board both ships.

6560. And was the provision which you received sufficient?—Quite sufficient.

6561. (*Admiral Inglefield.*) Were there any symptoms of scurvy amongst the people in your sledge journeys?—I had one case in my travelling party, under the late Admiral Osborn; but I do not know for certain whether it was scurvy or not. It was a swelling of one leg that the man had. As captain of the sledge I was left behind at the dépôt with him within about twenty days, with orders if I could get him some fowl, or anything of that sort, to get it, and to continue to bathe him, and keep him quiet until my commanding officer came back.

6562. You mean to say that you were left twenty days alone with this man?—Yes.

6563. With a supply of provisions?—Yes, with a supply of provisions.

6564. In a snow-hut, or in a tent?—In a tent.

6565. What time of the year?—I think about the latter part of June, or the early part of July.

6566. What provisions had you?—We were at a depôt.

6567. Whereabouts was that; up Wellington Channel?—I think it was called Cape Lady Franklin.

6568. What year was that, and what time of your journey?—That was in 1853.

6569. Then Commander Osborn went back to the "Pioneer," and then came back again to fetch you?—I believe he went to complete the survey where Captain Penny had been.

6570. Then he continued his journey, and picked you up on his return?—Yes.

6571. Did you carry lime juice on those sledge journeys?—Never to my knowledge.

6572. Did you take it always on board the ship?—Always on board ship.

6573. Was it drunk by the men on the quarter-deck, or carried to their messes?—Served out at the messes.

6574. Have you any opinion as to what the best age for a man is for arctic work? You have been on several arctic expeditions yourself, and you know whether, in your own case, you were quite as well equal to withstand the rigour of an arctic climate on your last voyage as you were on your first; what do you feel about it?—Every bit; quite as well.

6575. Do you think you were any better putting together your experience, and knowing what you had to expect, and how to meet it?—Yes.

6576. You think that you were, on the whole, better on your last voyage than you were on your first or second?—Yes.

6577. Then, of course, you had each time been recruited by a return to England?—Yes.

6578. And that was important?—Yes.

6579. When you were taken off, did you come home in the "Phoenix"?—In the "Talbot."

6580. When you came home, in what condition were the men of the ship that you belonged to when they were taken on board on Beechey Island?—Very good, I believe. I heard of no sickness.

6581. How did you feel yourself about remaining there another winter?—I was quite well, and willing.

6582. Has it occurred to you in thinking over the outbreak of scurvy in the last expedition that there is any reason that you can assign for it? Knowing as much as you do of sledge travelling, and having read the accounts of this last expedition, can you see any reason why this great outbreak of scurvy should have occurred, and none on other expeditions, or comparatively little?—Nothing more than that there may have been bad ventilation or not sufficient outdoor exercise; that is the only account I can give of it.

6583. Do you attribute much to using lime juice?—Yes; everyone ought to make use of lime juice on board ship. In my position that I was placed in as chief petty officer, I always made every man that I could see drink his lime juice.

6584. And what about sledge journeying; do you think it should be carried then?—I do not see how it is to be carried.

6585. We have got a preparation here in the shape of three or four lozenges, in which a man's whole allowance of lime juice on board ship is concentrated into four lozenges, and in that way could be carried.—I never had any scurvy, and no one I have been with yet in all the long parties that I was in had it.

6586. Take one of those (*handing a lozenge to the witness*). That is a quarter of an ounce, one day's ration on a sledge party.—That is lime juice, I can taste.

6587. That is the right sort of thing, is it?—Yes. Then the thing is, how is a man going to carry it; in a medicine chest?

6588. But four of those lozenges are four days' rations; four of those would constitute a full day's ration for shipboard; and, therefore, you see the ease of carrying it in that shape; but that is only a recent invention. Now, I should like to know whether the men suffered at all from the damp on the lower deck, and in which ship you suffered most from the accumulation of the condensation on the beams?—I have never suffered much myself, but I have heard men say that they had suffered from the damp in the "Enterprise."

6589. During the winter months?—During the winter months; but whether through the dampness or not I could not say. There were a few colds, but I do not think that arose from the damp.

6590. Did you get much game in the "Enterprise"?—Yes; looms, dovekies, wild fowl; all those things.

6591. But not musk oxen?—No.

6592. Have you ever seen scurvy amongst the Esquimaux?—Never.

6593. (*Dr. Fraser.*) I think you say that the provisions were very bad on board the "Enterprise"?—Yes.

6594. Was that the preserved meat?—Both the salt meat and the preserved meat.

6595. Had you vegetables at that time?—Yes, preserved vegetables.

6596. Were they bad or good?—Very good.

6597. What preserved vegetables?—Cabbage, carrots, turnips, and beetroot.

6598. Potato?—Yes, in the "Enterprise" we had one sort; in the "Resolute" and "Assistance" we had three sorts of potatoes.

6599. What sorts?—Edwards's we had in both expeditions, that was one sort; the other two, I think, were made by some French gentleman.

6600. Which of the potatoes did you like best?—The sliced potatoes, the French.

6601. You preferred those to Edwards's?—Yes, there was more of a taste about them.

6602. Were they dry?—Yes, you had to soak them, the same as you had Edwards's potatoes.

6603. Then you had plenty of potatoes and other vegetables on board the "Enterprise"?—Yes, that winter.

6604. But your other provisions were bad?—Yes.

6605. Had you a ration of vegetables every day?—Every day.

6606. A large allowance, or how much, can you remember?—I should think about half a pound.

6607. Had you potatoes every day?—No.

6608. How often?—I should think about three days a-week.

6609. Did you carry any milk?—Not on that voyage.

6610. Were the men in good health at the end of that winter in the "Enterprise"?—I should think they were. I did not see any in really bad health, more than just a common cold; nothing very bad, that I could see.

6611. You never heard of any scurvy?—None.

6612. You would have known if there had been?—I should think so.

6613. What was your position on board ship?—My position in that ship was quartermaster.

6614. Then the chances are that you would have known?—I think I should be pretty sure to have known.

6615. You do not recollect any men having their skin discoloured?—No.

6616. Nor complaining of spongy gums?—No.

6617. Nor complaining of great weakness or feebleness?—No, none.

6618. Had you much frost-bite?—I believe I and a man of the name of McIntyre had the severest frost-bite. I had frost-bite in both feet, and he in both hands.

6619. Lime juice was served daily?—Yes, daily.

6620. And taken pretty generally?—Yes.

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6621. You, I think, supervised the taking?—Yes, I was quartermaster.

6622. Had you any sledge journeys from the "Enterprise"?—One.

6623. Was that with Sir James Ross?—With Sir James Ross.

6624. A short one of ten days?—Yes. I could not go very far, because my feet got frost-bitten. I had to come back.

6625. How long was the expedition away altogether?—Forty-two days.

6626. Was that in spring?—Yes.

6627. What month?—I think it was in May.

6628. Do you remember what provisions were carried generally?—I recollect, before we left the ship, we boiled some salt pork and made some concentrated pea soup, and the other things were fresh provisions. Salt pork used to be for lunch; the rest were fresh provisions, that is, preserved provisions, but they were very bad.

6629. What about vegetables?—We had no vegetables.

6630. No potatoes?—To the best of my recollection, not. We had concentrated pea-soup, I think, instead.

6631. You cannot remember if there were any potatoes?—No, I do not remember potatoes.

6632. And had you lime juice?—Not on the travelling party.

6633. Your feet gave way?—Yes, my feet were frost-bitten. There were orders that no man was to go out of the ship by himself. This other man had made his escape, and I was ordered by the Admiral to proceed after him. Both my feet were frost-bitten.

6634. And you went on the sledge expedition after that?—Yes.

6635. And they again gave way?—Yes.

6636. Were you the only man on that sledge party who gave in?—No.

6637. Were there many men ill on that sledge expedition?—Yes.

6638. A large number?—Yes.

6639. Were they all ill?—I should think from ten to twelve men gave in.

6640. When did they give in?—Shortly after we left the ship, in the first ten days.

6641. Frost-bitten?—No, heavy travelling, I think; some of them, who had some very heavy snow, up to the middle in snow, and two men injured themselves, I know personally.

6642. What was the number on the party?—It was five sledges, and about forty men as far as I can remember.

6643. Now, when so many men gave up during the first ten days or a fortnight, was the expedition interrupted, or did it go on?—It still went on. As the dépôt-sleigh came back, the sick men went back with that sleigh.

6644. And the rest went on?—Yes.

6645. And you came back?—Yes.

6646. Do you recollect this party returning to the ship?—Yes.

6647. What state were the men in?—They were in health.

6648. All in good health?—All in good health.

6649. Now of those men who returned with you, were there any ill then after returning to the ship?—No; I think after some few days under the doctor they were able to go to work again.

6650. Who was the doctor?—Dr. Robertson; Dr. Matthias was the Assistant Surgeon at that time, I think.

6651. You never heard that any of these disabled men had scurvy, did you?—No.

6652. Your next long journey was, I think you say, under the late Admiral Osborn?—Yes, the longest journey.

6653. Of 96 days?—Yes.

6654. Was that from the "Resolute"?—From the "Assistance."

6655. Had you been wintering in the "Assistance" the winter before you started on this long expedition?—Yes.

6656. One winter?—One winter.

6657. And were the provisions good?—Very good indeed.

6658. You had not the same fault to find as with the provisions of the "Enterprise"?—No.

6659. Had you plenty of vegetable food there too?—Plenty of everything.

6660. And lime juice?—Yes, and lime juice.

6661. Was the health good that winter?—Very good.

6662. At the end of the winter?—At the end of the winter.

6663. No scurvy?—No scurvy; not half-an-hour's sickness.

6664. Was it a large party that went under the late Admiral Osborn in the journey which you mentioned?—I think about seven sleighs. The whole of that party was under the command of Admiral Richards, but Lieutenant Osborn was in the same party.

6665. The late Admiral Osborn was under Admiral Richards in the expedition?—Yes.

6666. Now do you recollect what provisions you carried on the sledge party?—We carried three sorts of pemmican, sugar pemmican, currant pemmican, and what we called plain pemmican.

6667. Which kind did you use most of?—I used to issue out one sort one day, and the other the other.

6668. Which was liked best?—As a rule, I think the currant pemmican was mostly liked.

6669. What else?—We carried biscuit at the rate of about a pound of biscuit per man.

6670. Had you potatoes?—Yes, potatoes as well. I do not remember what the ration was; it was a small quantity.

6671. What kind of potatoes?—Edwards's potatoes.

6672. Was that issued every day?—A daily ration; all made up in daily allowances.

6673. And was it cooked along with the pemmican?—Yes.

6674. There was no lime juice?—No.

6675. And did the men continue in good health?—In very good health, except a man whose leg was swollen a bit, but I did not see any discolouring of his leg. There was no complaint, any more than just weakness in the knees.

6676. Did he belong to the sledge of which you were captain?—Yes.

6677. You might not know if men were ill in the other sledges; I suppose you can only speak of your own sledge?—I can only speak of my own sledge, but Admiral Richards's party passed me when they came back, and they appeared to be all in very good health.

6678. You heard of no scurvy?—None at all.

6679. Your last expedition was in the spring of 1854?—Yes.

6680. You had between these two expeditions passed another winter, had you, in the "Assistance"?—I was out in the "Resolute" in 1850-51.

6681. Between the expedition under Admiral Richards and this one in the spring of 1854, you had passed another winter?—Yes, another winter.

6682. And did the supply of provisions remain good in the "Assistance"?—Yes, very good.

6683. And the lime juice was regularly issued?—Regularly issued.

6684. In what quantity?—Half a pint of lime juice per man, with water; that was about an ounce of lime juice.

6685. All the men were in good health, were they, that winter, in the "Assistance," previously to the spring sledging expedition?—No, not the whole of the winter, because we had two died.

6686. What did they die of?—One died through spraining his ankle, and I believe it turned to a

running wound; and the other died from dropsy, I think it was.

6687. But was the general health good?—The general health was good.

6688. No scurvy?—No scurvy at all, that I saw or heard of.

6689. Then you were absent from the 26th of March to what day?—To, I should think, some time in August; I was going to and fro. I did not go back to the ship again, to my recollection, till the "Talbot" came and picked us up.

6690. That was under Admiral Richards?—Admiral Richards started with the party first, and we were under different officers afterwards.

6691. Were your provisions the same in this expedition as you have told us already?—Yes.

6692. The meat was pemmican?—Pemmican, the same.

6693. Three kinds?—Yes.

6694. And you carried potatoes?—Yes, and onion powder and many things; and another very useful thing I found in arctic travelling in the long parties was a proposal of the late Admiral Osborn, to mix up some mustard and chili vinegar, and cut up some pickled onions, and he used to make every man have a little of that every luncheon.

6695. How much, a teaspoonful?—You took the corner of your hatchet and chopped a piece off.

6696. Did you carry this in every expedition you went?—No, only the last one under the late Admiral Osborn.

6697. That was the one of 96 days?—Yes.

6698. Did you carry it in the spring of 1854?—I used to carry it myself.

6699. Was it used generally by the men?—Yes.

6700. It was carried on these two expeditions?—Yes.

6701. The only long expeditions you had?—Yes.

6702. Did it last throughout the time?—Not the whole, but till some birds or something came along.

6703. Tell us exactly how you made it?—It was made along with a quantity of mustard, ground mustard, olive oil, and some pickled onions cut up, and some chilis cut up very fine. We used to put it into two empty eight-pound bullet tins and let it freeze.

6704. The two tins lasted one sledge?—It lasted until mild weather came on, and there was a chance of getting some game.

6705. Did each sledge party carry two of these tins?—I never knew of anyone else. This was something introduced by Admiral Osborn.

6706. And it lasted until you could get game?—Yes, it lasted perhaps over two months.

6707. Then it would last the greater part of this first long journey?—Yes.

6708. Did you give each man quite a teaspoonful to eat, do you think?—Yes, they would take a corner of the hatchet and chop off a little bit; I should think, as a rule, they had a teaspoonful.

6709. And did you manage to get game generally when the warm weather came?—We got very little on our journey. I think we had a couple of musk oxen and a calf, and two deer; that was the whole we had on our long journey with Admiral Osborn.

6710. And in the journey which you started on in the spring of 1854, had you much game?—No.

6711. Any?—Yes, a few birds; no large animals.

6712. Did you find any vegetables growing, any plants?—No.

6713. Nothing of that sort?—No.

6714. It was all covered with ice and snow?—Yes.

6715. You got no green vegetables?—No; we used to grow a little mustard and cress on board the ship.

6716. I refer to the sledging?—No, not then.

6717. And from the spring expedition of 1854, as

far as you know, the men returned in good health, excepting what you have told us?—Yes.

6718. You say the lower deck in the "Enterprise" was very damp and cold?—Very damp and cold.

6719. Do you think it was crowded or not?—No.

6720. Plenty of room?—Yes, I think the galley might have been altered, perhaps; it used to make the lower deck very damp.

6721. Was the ventilation bad?—The ventilation was bad at that time, I think, from the experience I have had since.

6722. Do you judge from anything else but the damp?—No, only from that.

6723. It did not smell stuffy or disagreeable?—No, nothing of that sort.

6724. Was the ventilation good in the "Resolute" and the "Assistance"?—Very good indeed.

6725. No great damp?—No, the deck was kept well dry.

6726. Was it wiped?—Yes, it was.

6727. If it had not been wiped it would have been very wet?—Yes.

6728. Before your sledge parties started from the ships, the men generally had a considerable amount of exercise?—Yes, they used to go regularly into training.

6729. Can you give us a notion as to what you did during the training? You told us of carrying about the stones; is that what you refer to?—This was the second expedition and the last expedition that we used to go in training before travelling, and we used to get to work at from nine to half-past nine in the morning, when all hands that could be spared, especially of those that were going on the travelling parties, used to go out with the officers a chase over the hills till twelve or one o'clock.

6730. Three or four hours?—Yes.

6731. Every day?—Every day; and this was from both the "Resolute" and the "Assistance."

6732. Was this in bad weather and in good weather?—No, weather permitting.

6733. Did the weather usually permit?—It would be very bad weather that would stop us from going.

6734. As a rule you went?—Yes.

6735. How many times in the week did you not go?—I should not think that we stopped more than twice a-week, including Sundays.

6736. How many weeks did the training last?—It used to commence the latter part of February, or the early part of March, as soon as it was nice daylight.

6737. You sometimes started on your sledging on the 26th of March?—That was only the last spring; we travelled to communicate with the "North Star."

6738. Had you four weeks training then?—We had none at that time, because we started as soon as the daylight would allow us.

6739. On those occasions, when you had training, for how many weeks did it usually last?—A fortnight or three weeks.

6740. Then, during winter you, of course, could not take so much exercise?—We had to take plenty of exercise outside; outside you must go.

6741. When it was dark?—You would go and do your work outside the ship the same as any other time.

6742. It was never so dark as to prevent that?—No, not the outside part of the work.

6743. How many hours did you have outside in the winter?—About five hours, I think. We used to go outside and work till about one o'clock in the "Resolute."

6744. All through the winter?—All through the winter we used to have five hours' work outside the ship.

6745. And you had exercise inside the ship too?—Yes, we were employed on deck and outside nearly the whole of what you may call the day.

6746. In fact, during winter it was never too dark, nor was the weather ever too bad to prevent your

Mr. J. Organ. getting nearly the whole day for exercise?—The weather was sometimes too bad, but never too dark to go outside.
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6747. How do you mean by "too bad"?—Blowing too heavy.

6748. What did you do for exercise then?—Exercised inside the ship then.

6749. How?—Running about the deck.

6750. Between decks do you mean?—No, on the upper deck.

6751. Running?—All sorts of games, anything for exercise; perhaps chasing a fox, or chasing a deer; all sorts of games.

6752. You always managed to get a great deal of exercise?—Yes.

6753. You were very particular about the washing of the men, were you?—Yes.

6754. Now you have told us something about that, but I should like to know how often each man was washed?—There used to be one mess told off every night.

6755. But I mean how often in the month would each man be washed?—I should think once a month. There were four messes with us, and one mess was told off every night for a bath.

6756. They got warm water?—Warm water supplied to them.

6757. The clothes were washed more frequently?—You would wash and dry the clothes as you possibly could.

6758. You think it important, do you not, that they should be clean, as clean as possible?—Yes.

6759. They became very dirty whilst sledging, I suppose?—You cannot wash then. You put on everything new and clean before you leave, you know, and then you have no opportunity of washing. When the weather gets a little bit milder you pick up a handful of snow, and wash your face with it, and wipe it as best you can.

6760. When the men washed on board ship, was there any officer to see that it was done?—The petty officer of the mess.

6761. He had to look after them?—He would be responsible.

6762. He would report a man that did not, I suppose?—Yes.

6763. Before you went on your sledge parties, excepting this exercise you told me about, did you make any other preparation; did you take any medicine?—None.

6764. You did not think it necessary to take a dose of medicine before starting?—No.

6765. You yourself, I think you have told us, were, at that time, at any rate, a teetotaler?—Yes.

6766. You never took spirits?—Nearly a teetotaler.

6767. Did you get much good from the spirits, do you think?—When I have felt myself very tired with a travelling party, or after a very heavy day's work, I would, perhaps, take half-a-gill, or if I was very cold and perspiring freely before I got to my bag, I might take half-a-gill then.

6768. That was at the end of the day's work?—Yes.

6769. Was it generally served out at the end of the day?—Twice in the day.

6770. When did you take tea?—Tea afterwards, after our pemmican at night, at the end of the day. We would have spirits when first we knocked off travelling, and while we were pitching the tent. By the time you got your bag your pemmican was ready, and by the time you had eaten that the tea would be ready.

6771. That was the only tea you took, was it?—Yes, we used to have chocolate for breakfast.

6772. Did the men always sleep well at night, as far as you know?—Yes, we slept very comfortably as far as we could expect.

6773. But what really did happen; did they sleep well?—Yes, they used to sleep well.

6774. Soon after turning in?—Yes.

6775. You did not find the late tea prevent any of the men from sleeping?—No.

6776. They were generally very tired, I suppose?—Very tired, and they would go off to sleep.

6777. Do you think it would be a great hardship to do without spirits in an expedition of that sort; I mean, are the benefits from its use so great that it would be a great hardship to give it up?—I should prefer a drop of spirit myself, and do without the tea. There are many times that a drop of spirit is very good when a man is dead cold after he has been dragging, and is perspiring; he gets dead cold before he can get anything warm inside him, before you have time to make tea. In my opinion a drop of spirits saved many a man.

6778. In fact, you found you could not get rid of your gear till you took a little spirits?—I found as a rule amongst the men, that after a drop of spirits they have done two miles extra, when they would not have done that two miles else.

6779. How do you know that?—The men have been travelling twelve or fourteen hours to get to a certain point, and I used to take a little drop of grog up. The commander used to tell me, "I want to reach that point to-night," and I gave the men a drop of grog. Without it they would not have got there.

6780. It cheered them?—Yes.

6781. How far from the point you wished to reach did you give them the grog?—Sometimes it might be a mile or a mile and a half; sometimes two miles.

6782. And they did the last mile and a half or two miles better than they had done the part immediately previous?—Just the time that the grog lasted they did it better than they had done in the middle of the day.

6783. I thought you said that bad ventilation was, in your opinion, one of the possible causes of scurvy in the last expedition?—I do not think anything else could be, unless it was that they did not take exercise enough.

6784. I thought your ventilation was extremely bad in the "Enterprise," and you had no scurvy?—So it was; I do not know anything more than what I read in the papers, about the dampness of the lower deck in the recent expedition. I have seen some of the provisions myself, and the provisions were very good.

6785. What makes you think that they had not sufficient exercise?—I read in the paper that they had only two hours outside in the winter.

6786. And you yourself had how much?—I should think from four to five hours a day.

6787. And you think two hours much too little?—Yes.

6788. But if they really had five hours, you think they would have had enough exercise?—Yes; I think a man, as long as he can stand outside, can never take too much exercise outside if he can stand it.

6789. Now during the winters that you passed north, did you have much game?—No, we never had much game in our ships, not in the three ships that I was in.

6790. Can you give me a notion as to how much you really had; did you ever have a week's ration?—No; we used to get most in the "Enterprise," at Port Leopold. We used to have a firing party go down, and they brought up sometimes as many as 60 looms; 60 of these arctic birds.

6791. For a crew of how many men?—Seventy-five we had.

6792. One bird was enough for a ration?—One or two messes would be served daily with a ration, I think.

6793. You had very little game?—Yes.

6794. And less in the "Resolute" or "Assistance" than in the "Enterprise"?—Yes.

6795. (*Dr. Donnet.*) Of the three ships to which you belonged, the "Enterprise," the "Resolute," and the "Assistance," which did you consider the best?—The last two were equal to each other, that is, the "Assistance" and the "Resolute"; the ventilation, the provisions, and everything, in one were as good as in the other.

6796. But the "Enterprise" was not equal to them?—Not equal to either one of them, not in the provisions, or comfort on board the ship, or anything.

6797. Was the ventilation deficient in the "Enterprise"?—Yes, from what I can see of it since I have been in other ships.

6798. Did you suffer more from moisture in that ship than you did in the other two?—Yes, than we did in the other two, that I could see.

6799. The "Enterprise" was in Leopold Harbour, was she not?—Yes.

6800. And the "Resolute" wintered on the floe?—The back of Griffith's Island.

6801. Do you think, in the position of the ships, one was more comfortable than the other?—No, I do not think so.

6802. Do you remember the number of days' darkness in the "Enterprise"?—No, I could not tell you that.

6803. Or in the "Resolute" or the "Assistance"?—No, but I ought to know; being quartermaster, it was under my notice every day to log it, but I could not say now.

6804. Do you think the number of days was more in the "Assistance" than in the "Enterprise," being further north?—Yes, I should think that it was a trifle more, but I could not give the least idea now.

6805. Did you take the same amount of exercise during every month of the winter?—There was the daily work to do outside every day, the daily routine of work to be done outside every day, and after that work was done, we had to go and fetch snow in, and many things. If there was no particular work to be done inside, the hands chased the fox, or played football; anything that gave cause for exercise.

6806. What number of hours' exercise did you take in the "Enterprise"?—We were kept at it from the first thing in the morning till well on in afternoon. We used to go to work about nine o'clock in the morning, and go to dinner at twelve o'clock, and go to work again at one, and knock off at three to half-past three.

6807. Was the amount of exercise the same in all the ships?—No, I think we used to take more exercise in dragging in the "Enterprise" than we had in the other expeditions. The exercise used to be different; it used to be running over the hills, training for travelling; but still there was the same daily work to be done on the other two ships as there was on the first one, that is, clearing away the fire-well and other different places connected with the ship, and collecting snow.

6808. Were you able to take as much exercise during the colder months of January and February as you did during the months of November and December?—Yes, I should think so from what I

can remember of it. When the wind was blowing very extraordinarily heavy, you would not care about facing it outside the same as if it were not blowing heavy.

6809. Had you not several cases of scurvy on board the "Enterprise"?—Not to my recollection.

6810. Was not Dr. Robertson ill of it after he returned from his expedition, when he fell down and hurt himself?—No, he fell down and hurt his back, I believe.

6811. What did Dr. Matthias die of?—As the report went, of consumption.

6812. In your conversations with the men of the arctic ships, did you ever speak of scurvy amongst yourselves in the "Resolute," "Enterprise," or "Assistance"?—I have heard conversations hoping that the scurvy would not break out when we used to get the very salt provisions, because our salt beef and salt pork of the first expedition were the common salt beef and pork of the navy; in those days it used to be very salt.

6813. Did you think at the time that salt meat might produce scurvy?—Yes, from what I had always been taught to believe; I have been always taught to believe that constant salt provisions will bring on scurvy, but I have always heard of lime juice as a preventative.

6814. Did you ever see scurvy amongst the merchant seamen?—I have heard men complain about their gums and their legs, but never in the navy.

6815. Where was that?—It was in one ship that was going into Quebec, in North America, a timber ship.

6816. Were you in a merchant ship at the time?—Yes, I was in the merchant service at that time.

6817. Did you lose any men from scurvy?—None, but one man was laid up, his legs swollen a good bit, and his gums were all swollen; he could almost shake his teeth out of his head.

6818. When on board the "Resolute," under Captain Austin, had you any deaths?—We had one man die with frost-bite in the toe. He was on a travelling party, and I think we saved him until he got on board the ship, and then he died.

6819. Do you remember the sledge party under Dr. Bradford, and do you know whether the men returned in good health?—I remember Dr. Bradford, but I have not any recollection of the party.

6820. I understand you to say that every man should take lime juice on board ship?—Yes.

6821. Why do you say so?—From what I have seen.

6822. What way is the lime juice given?—Issued to the messes the same as the grog or the bread, or anything else might be.

6823. As a preventive of scurvy?—I have heard that lime juice is a preventative of scurvy.

6824. Have you always taken your lime juice on board ship?—Always, as much as ever I could get of it.

6825. What did you take it for?—I was never much of a hand for salt meat; and for grog I never cared much on board ship; and I used mostly to make my dinner in hot countries of lime juice and biscuit.

The witness withdrew.

MR. WILLIAM MURRAY, *examined.*

6826. (*The Chairman.*) Enumerate the arctic expeditions in which you have been engaged?—I went in the year 1848 in the "Investigator" with Sir James Ross. I went next in the "Enterprise" with Admiral Sir Richard Collinson, from December, 1849, to May, 1855.

6827. Will you enumerate the sledge journeys in which you were engaged?—That was in the "Investigator," when we were away with Sir James Ross?

6828. Will you state the number of days you were absent?—I did not go a long journey with Sir James. I was along with the fatigue party. We were away, as near as I can recollect, about twenty days at that time.

6829. Have you an idea of the distance you travelled?—No, I have not.

6830. What was the next sledge journey in which you were employed?—There was not much sledge travelling done after Sir James Ross came back. We

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were only one winter out. The next that I went was in 1851, when we went from Winter Harbour with Sir Richard Collinson, when we were absent 55 days, as near as I can recollect, and travelled 811 statute miles.

6831. What was the next sledge journey?—The next was in 1853, when we were out 52 days, I think it was, as near as I can recollect, and travelled 780 miles.

6832. Were there any others?—Those are the two long journeys, but I was away on several occasions on shorter journeys. The captain scarcely ever left the ship without I was along with him.

6833. Were you captain of the sledge on those occasions?—No.

6834. (*Admiral Sir R. Collinson.*) The first winter you spent in the Arctic regions on board the "Investigator" at Port Leopold, did you not?—Yes.

6834a. Will you describe the state of the lower deck of the "Investigator" during that winter?—In the lower deck of the "Investigator" we had those great cumbersome chests that we had the first part of the time that we were in the "Enterprise"; in every other respect, with the exception of that, I think the lower decks were similar to what we had in the "Enterprise," except that we had more ventilation in the "Enterprise" on the last expedition.

6835. Did you go on board the "Enterprise" while the ship was wintering in Port Leopold?—Yes.

6836. Which vessel had the best ventilation, the "Investigator" or the "Enterprise"?—The "Enterprise," I should fancy, was best ventilated. She had a larger lower deck; it was a smaller lower deck in the "Investigator."

6837. Your provisions on board the "Investigator" on that occasion were of what description?—Very inferior.

6838. Will you specify what was bad?—The preserved meat was bad. Mr. Goldner, I believe, was the contractor at that time, and when we came home it was investigated into, and from what I could understand, he was fined something by the Government for sending out such inferior meat.

6839. Had you any reason to complain of anything else besides the preserved meat?—No.

6840. Was the beef good?—Yes.

6841. And the pork good?—Yes.

6842. What about the preserved potatoes?—They were very good.

6843. What quantity did you get of preserved potatoes?—I cannot say the quantity we had, I know we had a very good allowance.

6844. Had you enough to eat during the winter that you spent at Port Leopold?—Yes.

6845. What lime juice was issued to you?—I cannot exactly say what quantity of lime juice was in it, but it used to be mixed to about half a pint.

6846. What time was it served?—Between 11 and 12 in the forenoon.

6847. Was the lime juice good?—Yes.

6848. Had you any cases of scurvy on board the "Investigator" during that year?—I do not recollect any at all.

6849. Do you know whether there were any cases on board the "Enterprise" in that year?—No, I did not hear of any.

6850. Were any men sent to the hospital from the "Investigator" on your return to England?—No.

6851. Or from the "Enterprise"?—Not that I am aware of.

6852. Then you joined the "Enterprise," and the first winter which you passed in the "Enterprise" was in Winter Harbour, in about latitude 72°?—Yes.

6853. Will you describe to the Committee the regulations which were made for ventilating the lower deck, and warming the ship?—In the first winter, we had it housed round with snow on the outside, banked up with snow you may say, with

two feet of snow on the deck, covered with gravel on the top of the snow, with the fore hatchway house built round with a door, and inside fear-noughted; the fore hatchway of our deck was built round with a door, on the lower deck the fore hatchway was built round again with a door, and we had two scuttles down the sick bay for the ventilation of the lower deck. Now to go to the main hatchway we had a tent over the main hatchway.

6854. Were there any tanks?—Yes, we had a tank over the main hatchway to act like a condenser.

6855. Was the man-hole downwards?—Yes, the man-hole was downwards.

6856. Can you recollect ever clearing out this tank?—Yes, many times.

6857. What did you find in it?—A lot like what is inside a tent when you are travelling, I can hardly describe what you would term it, hanging about the tent like frosted moisture.

6858. Did you suffer much on board the "Enterprise" from drip?—No, not so much as I did in the "Investigator."

6859. What do you think that was owing to?—Having good ventilation and keeping a fire alight in the mainhold, it was always alight so many hours every day, as long as the quantity of fuel lasted that we had issued every day for the fire.

6860. Whereabouts did you sleep on the lower deck?—I slept abaft the fore hatchway the whole of the time.

6861. Were you on the same side as the Sylvester funnel, or on the opposite side, the star-board side or the port side?—I was on the port side.

6862. Therefore, you were not near to the smoke flues?—No.

6863. What took place in the mainhold during the winter?—We used to dry our clothes in the mainhold, and in fact we used to go down there if we had any rehearsal for the play or anything, we used to go down to practice there.

6864. Was the mainhold entirely cleared out?—All but the tanks, I think the tanks were not cleared out, there was plenty of room there.

6865. Were any of the men berthed there during the night?—I do not recollect any one sleeping there.

6866. Where did you wash your clothes?—We generally washed the clothes in the mainhold.

6867. What was the regulation for washing the clothes?—We used to have a regular day for washing clothes, but I really forget which; I cannot tell to a certainty.

6868. With respect to the provisions, what was the character of the provisions which you got on board the "Enterprise"?—The provisions were very good that we had. We occasionally found a tin of bad meat, but the others were very good.

6869. Was it sufficient?—Yes. No doubt the men could have put up with a little more, but still it was sufficient.

6870. During the winter, what was the arrangement with respect to game?—All the game that we shot went to the sick.

6871. Do you recollect whether you were out on shooting parties during the first winter?—Yes, I travelled scores of miles looking after game.

6872. Did you pick up much?—Very little the first winter.

6873. Coming to the sledge journey in the first spring, will you describe to the Committee what the general scale of provision was; what did you get for breakfast?—Cocoa and biscuit for breakfast; in the middle-day, salt pork, and a half a gill of rum; and at night, preserved potatoes and pemmican.

6874. And on your journey, did you get much fresh provision?—I think that I shot all that we got that time. I think I shot three hares at that time, besides a bear; on the 24th of May we shot the bear.

6875. Was any lime juice carried on the sledge?—Not that I am aware of; I never saw any.

6876. Did you take your lime juice on board the ship daily?—Yes. I used to drink it.

6877. Do you think that the men generally took their ration of lime juice throughout the winter?—It used to be like this. We used to get the lime juice in a kettle, and it used to be left on the table in the kettle; sometimes it was drunk, and sometimes it was not.

6878. It was not drunk at the tub?—No.

6879. Can you say whether any of the men refused to take their lime juice?—No, I never heard of one.

6880. You think all your messmates took their ration?—Yes.

6881. With respect to the second winter, will you describe how the second winter was passed through, as compared with the first winter?—I may say that the second winter was passed much similar to the first, only we shot more game in the second winter, and I think we were then on a short allowance of tea and cocoa.

6882. What was the condition of the men when we started on the second sledge journey?—I think we were as good then as we were at the first.

6883. And when we came back from the second sledge journey, were any of the men ill?—No.

6884. Are you not aware that some of them were attacked with scurvy on our return from the second journey?—No, I do not recollect it.

6885. Comparing the ice travelling on the second journey with that of the first, which was the greatest labour?—The second journey.

6886. What was that owing to?—We fell in with the heavy pack-ice, and the sleigh broke down. I returned after the sleigh broke down; that was our first falling in with the heavy ice, and I went back to fetch a fresh sleigh. There was a return party who returned to the ship.

6887. So that comparing the two years, the work was harder in travelling in the second year than it was in the first?—Yes.

6888. With respect to the third year, what was the general condition of the people at the end of the third winter?—They were all very well, there was only one man, I think, that we had to complain of, and that was a man named Davison; that was the only one we had sick, I think, and it was not through scurvy, I know.

6889. Previous to the third winter, was there a considerable labour in getting wood off to the ship?—Yes, we had to walk many miles ashore to look for wood to wood the ship. I think we were near about six or seven miles from the shore.

6890. So that the third autumn it was a very arduous labour?—Yes, the worst of the three.

6891. When the third winter was over, you went with me direct to the north, did you not?—Yes.

6892. Will you describe to the Committee the character of the ice that we fell in with on that occasion?—It was very heavy ice, large hummocks of ice; in fact, it was very hummocky, you could scarcely get the length of the sleigh hardly at all to travel; it was very bad indeed.

6893. The sleigh had constantly to be unloaded, had it not?—Yes, the sleigh had to be unloaded, and we had to be going backwards and forwards with the sleigh, taking the provisions backward and forward.

6894. What was the condition of the snow between the hummocks?—In some places you would go down up to your waist.

6895. What was the usual routine during the winter, as far as the employment of the ship's company went?—We breakfasted at eight o'clock, cleaned the lower deck, turned the hands up at nine o'clock, a walking party outside till half-past eleven, then in to dinner. If the weather was too severe, so that we could not stop outside (we were forced to be out of

the ship) we went into the skittle alley; we built a skittle alley with snow, and a billiard room we built with snow, and we had to go in there out of the weather.

6896. The lower deck was kept clear?—Yes, the lower deck was kept clear.

6897. In the evenings, what did you do with yourselves?—We either went to school, or set to work to make or mend, or whatever we had to do with our clothing.

6898. What was your age when you joined the "Investigator" in 1848?—Twenty-two.

6899. What do you think ought to be the age for a man to go to the arctic regions in full vigour?—Something like I was myself, not over thirty for a man to do any work.

6900. You visited the "Alert" and the "Discovery" before they sailed from Portsmouth the year before last, did you not?—Yes, I went down on purpose to see them.

6901. What is your opinion with respect to the accommodation on board the "Alert" and the "Discovery," as compared with that in the two ships in which you yourself served?—I made the remark there that they were not near so comfortable as we were in the "Enterprise." I could find fault with several things there that I could see, and things which we had done away with in the "Enterprise." We had done away with those large chests, but in those other ships they had chests much larger. The cooking apparatus I found fault with; certainly it was a better apparatus, but it was much too large for the ship; it took up a lot of room on the lower deck.

6902. Was the "Alert's" accommodation for the men as large as it was on board the "Enterprise"?—No, not nearly so much; they did not have more than half so good a lower deck as we did.

6903. Did you visit the "Discovery" as well?—Yes, I went on board both ships.

6904. You had the impression that you had more space on board the "Investigator" and the "Enterprise" than they had on board the "Alert" and the "Discovery"?—Yes, I spoke of it when I came back and went to Harwich.

6905. But you made no measurement?—No, I could see by looking at it with my eye.

6906. Then it is only your impression?—That is my impression.

6907. (*Admiral Inglefield.*) What opportunity have you had of seeing cases of scurvy?—I have never seen any man with scurvy.

6908. Have you never seen during all your arctic experience a man attacked with scurvy?—No.

6909. Have you formed any opinion as to why the men in the recent arctic expedition suffered from scurvy so much, while other expeditions were comparatively exempt?—I have thought this way within myself, that perhaps they did not have vegetables enough along with them; that was my impression. On board the "Enterprise" we used to have preserved potatoes, preserved vegetables, preserved carrots, and all that, every day; so that kept the scurvy from us. That was my opinion when I read of these men having the scurvy.

6910. What age were you when you were out on your Arctic expedition?—I was 29 when I came home, when I was paid off.

6911. How many years were you out altogether?—From 1848 to 1855; I was out four winters.

6912. Have you suffered at all from it since?—None whatever.

6913. You never had any symptoms of scurvy?—No.

6914. You took your lime juice regularly?—Yes.

6915. Did you get much sorrel and scurvy grass?—No.

6916. Were you ever on short rations?—No, not particularly short.

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6917. You were never three upon two?—No; the only time we were short was when we were travelling, we could have eaten a little more then.

6918. In your sledging journeys did you carry lime juice?—No.

6919. Did you take plenty of exercise in the winter?—Yes, we were out on the ice every day.

6920. For how many hours?—For about five and a half a-day.

6921. Do you attribute to that your great exemption from scurvy?—Yes. I think the more exercise you have out there the better you are; I am only speaking for myself.

6922. With reference to the use of tea and rum in sledge journeys, do you impute any special advantage to either one over the other?—I should say that having a hot meal in the middle of the day would be losing time. That is why I should prize the half a gill of rum, for you can go on after having your half a gill of rum; it wastes such a lot of time in the middle of the day having tea.

6923. Do not you find that men who drink their rum in the middle of the day, in the middle of their work, receive a certain amount of impetus which wears off very quickly, and then lassitude takes place?—No; I will speak from the men that I travelled with in the "Investigator." There was a man of the name of Fawcett, who was out along with Sir James Ross; he was a teetotaler, and he had not been away from the ship many days before he had to be dragged on the sleigh, but I may say he broke the pledge very shortly after.

6924. And he got better, did he?—After he got aboard the ship; he was a very large man too. I was the biggest man, I think, that was travelling along with the Admiral.

6925. Had you many teetotalers in the "Enterprise"?—I did not know of but one.

6926. And this one in the "Investigator" was a very bad example?—Yes.

6927. What is your opinion as to the best age for men engaged in arctic expeditions?—I should say men should not be over 35.

6928. What should you say should be the youngest age?—As to the youngest age, I should say I would take myself. I was about 22 when I went.

6929. Was your lower deck pretty dry?—Yes, every day we used to have the deck cloths up; it was quite dry under the deck cloths.

6930. It was over head where the moisture was?—Yes, over where I slept there was an iron bolt through the deck, and we had fearnoughts over all the heads of those on the lower deck.

6931. And that absorbed the moisture and prevented condensation?—Yes, and in the morning my breath used to be frozen on that fearnought that was right over my head.

6932. If you were engaged in another sledge journey, would you take lime juice with you?—I should not trouble about it. I fancy you might carry it, it would not hurt anyone, but I believe it would be worthless from what experience I have had.

6933. It was taken regularly during the winter months; do not you think the men derived any benefit from it?—By taking it in the winter months I do.

6934. If it is good during the winter months, surely it is good while you are travelling. I am supposing that it could be taken in a concentrated form, such as we have had now prepared and put before the Committee, so that there would be no trouble with thawing or mixing it with water?—I think, myself, that it could be dispensed with.

6935. Here is a specimen. The lime juice has been concentrated, and one of these lozenges is equal to a quarter of an ounce of lime juice concentrated. Will you taste one of them (*handing the same to the witness*)? You see that is a very easy way of taking lime juice without any melting or mixing with water?—Yes, that might do very well here.

6936. Why would not it do in the arctic regions?—When you are travelling you find that you want some other moisture in your mouth.

6937. We suppose you put it in your mouth and take a drink of your tea afterwards?—But we do not have tea in the middle of the day.

6938. It does not matter when you take it in the 24 hours so long as you get your ounce of lime juice a day. Four of these lozenges would be equal to an ounce of lime juice; it is a new preparation, which has just been made. If it was good to carry during the winter, and if it could be as portable as that, it would be worth taking on sledge journeys, would it not?—Yes, I do not say that it would be doing any harm; it might do more good than harm, but it is a thing really that we never used to think about, was lime juice, when we were travelling.

6939. Was there much depression of spirits amongst the men during that voyage in the "Enterprise"?—No.

6940. Still, they must have known that their position was rather a hopeless one, must they not?—I never heard anyone say but what we fully expected we should get out; we all had that confidence in our leader, that we thought we should get out all right. I never heard anyone say that he ever thought of such a thing.

6941. Still, you all must have known that Sir John Franklin did not get out, and what happened to him might have happened to you?—It would not do to think like that; we should not get along at all if we thought that.

6942. If every man in the ship thinks so, as you say, it is the best thing they can do; but still it is not everybody that will take that view of the case, and sometimes there are desponding spirits which are acted upon more or less by that very feeling. Were there any amongst your men who suffered at all from depression of spirits?—No, I do not know of one. In fact, when we got to our last winter quarters we made sure we should get out or get somewhere where we could travel. We were in the vicinity of the Mackenzie, or the Cowell, or the Coppermine, or any of those rivers; we knew, perhaps, their vicinity, and I do not think there was a man on board the ship but who thought we should get home right enough.

6943. What did the dried wood consist of that you collected?—This was wood that came down the rivers with the freshes.

6944. Trees, in fact.—Yes.

6945. You used it for firewood?—Yes, we had to go ashore and look for it, and to travel six miles along and six miles aboard; that was, I think, the distance we were from the ship.

6946. What quantity do you think you collected?—Some days we would get very little; we had to go a long way for it, and had great difficulty in getting it out of the snow. We had to dig it out with pickaxes to get it out, but I think the men were in as good spirits at the end as when we first started.

6947. What stove was it that you had upon the lower deck?—A Sylvester stove.

6948. And that you found warmed the ship perfectly?—Yes.

6949. You found that in the "Enterprise" you were much better equipped than in the "Investigator," were you not?—Yes, we were, because in the "Investigator" we had not so large a ship as the "Enterprise;" and another thing was, that the lower deck was more encumbered, and it was not so nicely ventilated as we were in the "Enterprise," in which the lower deck was much wider.

6950. Is there anything else that occurs to you to mention to the Committee with reference to this outbreak of scurvy, as to its causes?—The only thing, I think, is this. I have thought it over a good many times, and talked about it. I think, perhaps, the men got rather down in spirits; they

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did not exert themselves; they got stopping in the tent. That is the only thing I know of, the men being in the tent they lost their spirits. I do not know what the ages of those men were.

6951. It is recorded that they were under 30, and that there was no man in the expedition over 30 years of age except the captain, and there were many of them 22, 23, and 25, the average age being 25?—The only way that I can account for it is this, and I made the remark more than 100 times since they came home, that if they had, perhaps, been a little more persevering, and kept more close to their work while they were travelling, they might have been better.

6952. But they broke down with scurvy, and it was impossible then?—But I can speak of two parties that were away along with us on the 24th of June who went out to look for the party that went to Melville Island. They were ten miles closer to the ship than we were, and yet we were aboard the ship sixteen days before them, and I put that down through the perseverance of our leader; that the leader that they had did not persevere as the one that I was with did. We were sixteen days on board before the other party.

6953. And they were ten miles nearer?—Yes.

6954. (*Dr. Fraser.*) You think that lime juice is a good thing to use, do you not?—Yes.

6955. Why?—We say it is a preventative of scurvy; not that I ever had any scurvy. When I was in the navy we used to get lime juice served out, after being fourteen days on salt provisions.

6956. And you had plenty of it on board both the ships, the "Investigator" and the "Enterprise"?—Yes.

6957. Along with vegetables in abundance?—Yes.

6958. Both potatoes and other vegetables?—Yes, and potatoes and other vegetables, preserved potatoes and carrots, and we had turnips, and we had beet-root as well.

6959. There were some vegetables issued every day?—Yes, every day.

6960. Do you know how much?—We used to get a 4-lb. tin of vegetables between six of us. There used to be a good deal of vegetables in our ox-tail soup; we used to get ox-tail soup twice a week, and vegetables in it.

6961. Was that 4-lb. tin used every day?—No, we did not use the 4 lbs. every day. We used to have potatoes one day, I forget the quantity we used to have, and then we would have, perhaps, carrots the next day.

6962. You do not know what quantity of potato you had?—No, I do not.

6963. Was it about as much as you could eat?—A very good meal.

6964. As much as you generally eat on land?—Yes, as much potato as I should eat now.

6965. And as much vegetable, generally speaking?—Yes.

6966. And besides that you had lime juice?—Yes.

6967. Was it an ounce of lime juice?—I do not know the quantity.

6968. But you did not carry any lime juice when you were sledging?—No.

6969. Was that because it was difficult to carry, do you remember?—I do not think it was because it was difficult to carry. I think it was because we did not think we required it, and we would not take anything more than was necessary. It would have had to be carried in a bottle, and it would very likely get broken. We did not carry anything that we were not absolutely obliged to carry.

6970. In your sledging expeditions did you carry any vegetables?—Preserved potatoes.

6971. How much do you think was generally eaten of preserved potatoes every day?—We had the same quantity when travelling of preserved potatoes as we had on board ship.

6972. But you only had it occasionally in the week, I think, on board ship?—Occasionally in the week.

6973. Did you have it once a-day in travelling?—We had it every day in travelling.

6974. Was this allowance every day as much as the daily allowance on board ship?—Yes.

6975. When you got it on the sledging expeditions, you got as much as you used to get on any day on board ship?—Yes.

6976. Therefore you got more potato when you were travelling than you got when on board ship?—Yes.

6977. What quantity of potatoes did you get?—I cannot remember.

6978. You had no scurvy, I think you say?—No.

6979. And you never saw it?—No.

6980. Had you any game?—We got game and we got some fish the second year.

6981. Was that mainly deer?—Yes. We caught a good deal of fish in our second winter quarters.

6982. How did you get it?—We caught it with a seine in the lakes.

6983. You broke the ice, did you?—No, the ice always melts around the shore first, and then we had one of Mr. Alcott's boats, and we used to pump it up with the bellows, and put the poles and seine in boat, and then go round and shoot the seine properly, the same as you would on the lake.

6984. Was it a fresh water lake?—Yes.

6985. What fish was it?—Salmon.

6986. Were they large fish?—Yes, some of them were very large.

6987. Did you get a good many?—Yes; the largest haul that we ever had, I think, was 1,247 fish.

6988. How large were the fish?—I think the smallest was 3 lbs., and I think the largest was somewhere about 25 lbs.

6989. What was the date of that?—On the 9th July, 1853, there were 1,247 salmon caught at one haul.

6990. You could not eat all of them, could you?—While we were eating them we were not eating our salt provisions, we were saving them; all the time we were out shooting or getting those fish, we were not eating the provisions aboard ship.

6991. You were living to a great extent on this fish?—We were living on what we could catch.

6992. Did this fishing last for several months, or how long?—We would go fishing after we came back from travelling, and we had a month or six weeks of it.

6993. When did the fishing season commence?—As soon as the ice began to thaw from the shore.

6994. About what month would that be?—In July.

6995. When did you get your game chiefly?—We could get game about July and August.

6996. You got none during the winter, I suppose?—Very little during the winter.

6997. You saw the "Alert" and the "Discovery," I think you say, before they started?—Yes.

6998. Was that after they had been furnished, or while they were empty?—They were ready for sea when I went down to see them.

6999. And then you thought the accommodation seemed a little limited for the number of hands?—Yes, it was.

7000. I think there were something like 70 men in one ship and 60 in the other?—Yes, it was a very small space to give to them. I made the remark on board the ship, and said that I thought they were cramped up a good deal on the lower deck.

7001. You thought that the space was rather too small for the number of men who had to sleep within that space?—Yes; and as I knew they were going, I said that the captain would break up all those chests as soon as he got to sea.

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7002. What chests were they?—What the men had to put their clothes in, and they made seats of them to sit on, as well as to put their clothes in them.

7003. (*Dr. Donnet.*) I think you said that had the men in the late expedition worked better, and been more persevering, they would not have had scurvy?—That is my opinion.

7004. But when I say that the officers who have been before us have told us that those men worked well, and worked cheerfully, and, though ill, they would have gone as far as their officers wished them, would that change your opinion?—No, it would not.

7005. I have mentioned this in justice to the men, for, from the evidence, I believe they must have worked very hard. What was the depth of the snow and the nature of the ice that you went over?—You went on travelling unless you came where it was very hummocky, and if there is any travelling at all the snow is quite hard. You can cut it, you have got to cut it out. The sleigh would hardly make any impression upon it, or, if it makes an impression, that is all.

7006. Do you know what the height of the hummocks was?—We fell in with some hummocks of ice 20 feet in height.

7007. Were you obliged to cut through them, or did you go around them?—We got round them. You would never think of cutting through them; it was a mistake thinking of pioneering a road out there.

7008. In the expedition especially under Captain Markham, they were frequently obliged to cut across those hummocks?—In my opinion that is a mistake.

7009. They had no other way to go?—They could go round them.

7010. No, that was impossible?—Then it must be a very small hummock for them to go through it, or else they would never get through a large hummock of ice; the hummocks would be about as big as this building. They would never pioneer through a hummock of ice that would be 20 feet high; I know they could not.

7011. The ice over which Captain Markham travelled was of so hummocky a nature, that they were obliged to go over many parts?—Yes, they could go over it; I quite agree with that.

The witness withdrew.

ROBERT BARNES, ESQ., M.D., *examined.*

R. Barnes,
Esq., M.D.

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7020. (*The Chairman.*) You are a Fellow of the Royal College of Physicians?—Yes.

7021. You are the author of a report on the occurrence of sea scurvy in the mercantile navy, based chiefly on experience at the Seamen's Hospital Ship, "Dreadnought," and prepared at the request of the office of the Privy Council?—Yes.

7022. (*Dr. Fraser.*) The report which has been named was prepared by you a good many years ago, I understand?—Yes, in 1863.

7023. Had you before that date directed your attention to this subject?—I had been physician to the "Dreadnought" for some years, and I had been constantly enquiring into the matter.

7024. You had occasion in connection with the report of which the Chairman has given us the title, to enter very fully into the general history of scurvy, had you not?—Yes, I had.

7025. And you were able to convince yourself, I think, that probably previously to its frequent occurrence amongst seamen, it was a common disease on land?—Quite so; there is abundant historical evidence of it, but in all its conditions one can trace the privation of vegetable food. That is a constant condition in all the enquiries that I have made.

7026. Can you now give us any examples of such early outbreaks?—By referring to my report there is an instance in the history of the British army in

7012. Is there anything more that you would wish to say with regard to diet?—I think that they ought to have had more vegetables.

7013. Do you think that the want of vegetables had some action in the production of the outbreak of scurvy in the late expedition?—Yes.

7014. Do you know what the general opinion among sailors was regarding the cause which produced the scurvy?—It is their opinion generally that living on salt meat continually, and nothing but salt meat, and no vegetables, would give them the scurvy; but my opinion is, that if they had had more vegetables when they were travelling, it would have been better than lime juice.

7015. The sledging party carried two ounces of preserved vegetables, do you think that quantity was sufficient?—No, I do not think so myself; but, from what I have read of these travelling parties, I cannot help making the remark: Fancy a man putting his bacon in his tea to thaw it to eat it. That is a mistake. They could eat it like a bit of cheese if it was frozen, and they could eat it better frozen than if it was thawed. I know I could eat a bit of pork when it was frozen. Then there was the stopping at the mid-day halt to have warm tea. The whole fact of the matter is, they were indulged too much, that is all about it.

7016. Did you ever take tea in any of your sledge journeys?—No. We had cocoa for breakfast, and the next hot meal we had was pemmican and preserved potatoes, and at night tea; but we had nothing warm at the mid-day halt; we had only half a gill of rum and the pork.

7017. You say that had they had more vegetables, the scurvy might not have broken out, but do you not think that lime juice is a good substitute for vegetables?—I do not think so. I put more faith in vegetables than I do in the lime juice, because, for instance, I think myself that these lozenges, after they have been made a certain time, and are taken out there, the virtue will go out of them.

7018. Do you think that lime juice should or should not be carried in a sledge journey?—I will not say that; that is according to the captain's own ideas.

7019. What is your own opinion?—My own opinion is that it could be dispensed with and done without.

the Crimea. But before that, in the years 1846 and 1847 there was an extensive epidemic of scurvy in Scotland, the history of which was given by Professor Christison. There had been a failure of the potato crop. The diet of the sufferers consisted almost exclusively of bread and coffee with sugar, but without milk, which is an important point; of salt fish and fresh meat they had plenty. The thing wanting was the vegetables.

7027. Do you know why they had no vegetables?—There had been a failure of the potato crop; and they were working in gangs, and they were taking their food from the tommy shops of the contractors, by whom vegetables were not supplied to them; and that has happened with several gangs of labourers employed in different parts of the world.

7028. For a long time anterior to the date of the occasions which you refer to, scurvy has occurred, I think, very extensively, has it not, in the north of Europe?—Yes.

7029. And likewise amongst the Crusaders?—Yes, amongst the Crusaders too, and with regard to them mention is made of the fact of the barbers being employed in cutting off the gums of the sufferers, to enable them to eat.

7030. Do you remember any facts with reference to the occurrence of scurvy in Holland, which point

to the absence, for instance, of vegetables?—In the last century, that country was badly drained, and therefore badly cultivated. The food of the people consisted chiefly of salt pork and beef, and scurvy then was very prevalent. Now Holland and Belgium are great vegetable-producing countries, and they do not know scurvy any longer.

7031. I think you were going to tell us something with respect to the Russian war?—In the Crimean war we know this fact, that in the ships of the Navy, the men had no scurvy, because they were provided with the ordinary navy diet, which is good, but the men ashore did not have it, and they had scurvy. No doubt the Committee have had evidence better than I could give to them, upon this point. The outbreak of scurvy in Millbank Prison is another great example, where we had it in London in the year 1823, and perhaps the Committee have already had that before them.

7032. Without troubling you further with these illustrations, perhaps you will favour us with the general lessons taught by them, and by any other illustrations that you may have come across?—If I might sum them up, I should say that all the historical evidence which has been produced in later years upon the observation of competent observers, and of oneself at the “Dreadnought,” shows that the only one constant condition is the privation of vegetable food; everything else has been tried under every variety of circumstance, of extreme cold, extreme heat, extreme fatigue, living at ease, and the lazy life that prisoners have sometimes, or soldiers cooped up in garrisons, or undergoing the most arduous labour, in every variety of circumstance in which scurvy has broken out, we meet with that single condition of privation of vegetable food.

7033. Is that the single condition, so far as your knowledge allows you to arrive at an opinion, connected with the outbreak of scurvy, on sea as well as on land?—Yes, it is a special thing there. When I found it on board the “Dreadnought,” I used to take great pains about it. Sometimes we had five or six scurvy men brought on board, and the mate or captain has come on board with them, and I have seen them and cross-questioned them about the matter and said, “Did you ever have scurvy amongst the officers in the cabin?” and I have been laughed at as asking an absurd question. The officers never have it; they do not know it even in the merchant service, and it is because they have there certain luxuries, vegetables, and preserved meats, and, perhaps, bottled beer, and various things which the men do not have; but I see that all other circumstances being alike, excepting that one thing, the men have scurvy and the officers escape.

7034. Where fresh vegetables cannot be obtained, what is the substance which most effectually acts as a substitute?—Experience upon that point seems conclusive in favour of lime juice as the most available and most effective.

7035. Can you inform the Committee if any remarkable change has occurred in the frequency with which scurvy occurs in the navy since the general use of lime juice?—I have understood from enquiries made by Dr. Bryson, at that time Medical Director of the Navy, that it has become almost unknown in the navy, under ordinary circumstances, since the introduction of lime juice and vegetable food.

7036. When do you think lime juice was generally introduced?—It came in at the time of Dr. Lind, about 1795.

7037. Since the introduction of lime juice scurvy has steadily decreased until it has become an extremely rare disease in the navy, is not that so?—Extremely rare; so much so, that I am not surprised to find that the officers in this expedition did not know it when they first saw the symptoms.

7038. Is the prophylactic power of lime juice as decidedly shown by experience in the merchant

service as in the navy?—Quite so. It is unknown now in the emigration service, I am told. It was unknown even before steamers were introduced, when the voyage to Australia took about 90 to 100 days. It was unknown then after the introduction of a proper supply of lime juice and vegetable diet. Now it takes only a matter of six weeks, that is, 40 or 50 days, and there is no scurvy in the emigration service.

7039. That is the service in which they are most particular, are they not, with regard to the issue of vegetables and lime juice?—Yes.

7040. And the quantity of vegetables, I understand, is very large?—Yes, it is larger than it used to be.

7041. Do you remember the proportion of potatoes?—No, I do not remember the amount of the ration of potato; I understand it is large.

7042. Have you had the papers or any of the papers of the recent expedition placed before you?—I have had these, the scale of diet of the Arctic Committee, the diet list of the sledging parties, and the reports of the commanding officers of the sledging parties.

7043. You have read them over, I dare say?—Yes, I have.

7044. Have you formed any opinion, from the evidence contained in those papers, respecting the cause of the occurrence of scurvy in the recent expedition?—It seems to me obvious enough that it was the defect of vegetable food in the sledging parties. There was no scurvy on board the ship until the sledging parties went away; they were exposed then to an immense amount of fatigue and cold, and distress, and they lost their lime juice.

7045. You think, in short, that it was owing to the fact that the vegetable food was too small in quantity?—Quite so; I see only two ounces of potatoes was the ration for the sledging party; that certainly appears to be insufficient.

7046. Have you in looking over these papers observed that at least one case of scurvy in each of the two ships occurred with men who had not been using the sledge party dietary?—I did not notice that fact.

7047. You have, of course, noticed that the cases of scurvy amongst the sledging parties commenced within a few days after they left their respective ships?—Yes, I have noticed that fact.

7048. Have you arrived at any opinion as to the minimum time between the operation of the effective cause and the production of the disease of scurvy?—No; that must require, of course, very great consideration. You must look at the different circumstances under which the men were placed. In this report which I drew out some years ago, there is a table which shows the length of time the ships were at sea, from which the men were brought having scurvy, and it varied from 60 to 167 days, but in those cases in the merchant service, the general dietary and treatment would be very inferior to what is known in the navy, and the scurvy would occur much earlier in those cases, I have no doubt. One would expect men treated as they are in the British Navy to hold out much longer.

7049. With respect to the scale of dietary on board ship in the recent expedition, do you think that it is one which may be considered satisfactory on the whole?—I consider it admirable up to a certain point for a certain time.

7050. Do you mean to say, that if it were used for a very long period of time, it would require the addition of some other articles?—It would require modification.

7051. Can you give us an idea of what modification you refer to?—In proportion as the men got more and more exposed or liable to it, they would require a larger proportion of vegetable diet. I mean after long exposure to the conditions which lead up to this liability to scurvy.

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7052. You mean, that although it might be sufficient for a few weeks at the commencement, or it may be even for a few months, it would not do for eight or nine months?—No, it might do for six months, but after that they would require a variation in the direction of more vegetable aliment, and if I might mention another thing, I should say that preserved milk might very usefully be added.

7053. As a general ration do you mean?—Yes, as a general ration.

7054. To what extent would you think it necessary to increase the vegetables?—Perhaps I could only give an approximative answer. I could not pretend to be quite prepared to state very accurately. I see four ounces of potatoes in the dietary. I think that ought to be doubled. The other preserved vegetables might be modified; to get a variety is the great point; and two ounces of milk, and fruit if possible. "Two ounces of fruit per man twice a week;" one would increase that to three or four times a week. Then I do not know if there was any supply of beer.

7055. There was no general issue of beer; what do you think as to that?—It would be much better than spirits or wine.

7056. You believe that beer is decidedly antiscorbutic?—Yes.

7057. Do you think that under a dietary such as this, scurvy ought to occur?—Well, it is a matter of experience, but I think that if the men were not exposed to great hardships in the sledging parties, this diet would keep the men safe for a year, with very little modification, such as I have mentioned.

7058. Notwithstanding that they were exposed to conditions of climate which were very unusual and also very trying?—Yes, but not sledging. With some modifications, that dietary, I think, would be sufficient; of course I speak with some reserve on that point. I would much rather that you should take the opinion of Sir Alexander Armstrong.

7059. I understand, however, that you do not think that this scale of dietary is in any way accountable for the occurrence of the scurvy?—No, I think not. I should say that after a time, this dietary, wanting the modifications that I have mentioned, was becoming insufficient as a preventative; and then in the sledging parties, going off with this dietary even cut down, it would almost surely produce scurvy.

7060. You know what the sledge party dietary is, I suppose?—Yes, I do know; I have it here.

7061. Do you think it a good one, with the exceptions to which you have referred?—It is very defective in the main point, in the vegetable diet; only two ounces of potato, the only thing of any value as an antiscorbutic in the dietary that I can see; and the pemmican which is not very much to be depended upon as an antiscorbutic.

7062. Do you think it antiscorbutic at all?—I am not sure that it is; I have no experience of it, but I can only infer from the proportions of vegetable matter mixed with it. I have no faith in it as meat at all.

7063. But I think there is no vegetable matter mixed with it?—There is plain pemmican, and there is pemmican made up with other things; I do not know which it is that was used in this case.

7064. The two varieties were used, the plain and also the sweet, having currants and raisins?—And condiments, I expect, that would not be of much value, I am afraid.

7065. What do you think was the effect upon the health of the men of long confinement during the winter?—That must be a matter of observation to those who saw it. In the long run it must tell in a depressing way, and render them more liable to scurvy if they had not a full diet of an antiscorbutic character.

7066. And the long absence of light?—The long absence of light and long exposure to cold would all tend to impair the nutritive powers of the system.

7067. And if the men during that confinement had lived in a somewhat vitiated atmosphere, what effect would that have?—They would be still more liable to have their nutrition impaired, and therefore less able to extract the antiscorbutic virtue out of their diet.

7068. And having been subjected to all these conditions which, in your opinion, lower the standard of health, and having also lived upon a dietary which latterly did not contain a sufficient amount of that material which you regard as essential to the warding off of scurvy, and being then called upon suddenly to undergo extraordinary and unusual physical exertion, with a dietary almost totally devoid of the essential article to which you have referred, do you think it wonderful that scurvy should have made its appearance within ten days or a fortnight?—No, it is quite what we might have expected, from all we know of the history of scurvy; and that bears somewhat upon the question noticed in some of the reports, upon "acclimatisation." I know of no evidence in support of the theory that acclimatisation will enable a man to endure or to resist the onset of scurvy more; I think the liability to the onset of scurvy increases day by day with time.

7069. You think that men do not become acclimatised?—No.

7070. Do you think if the men had been prepared for the great exertion which they subsequently underwent by some special training, the occurrence might have been altogether warded off?—No.

7071. You think that this diet could not have formed the subsistence of the men without scurvy occurring sooner or later?—I do not think it could.

7072. Have you anything further to say in reference to the fact that it did occur with such unusual rapidity after this, which you regard as the prime cause, had come into operation?—No, I think not; I am not surprised, as I have said, that after some months' exposure to all the deteriorating circumstances, and the diet getting less and less antiscorbutic, and the men being then put upon unusual exertions and defective rations, the scurvy should appear quickly.

7073. Do you think that if lime juice had been carried, scurvy would have been prevented?—It would have postponed it, and possibly have prevented it for a certain time.

7074. Do you think, if lime juice and more vegetable food had been carried, scurvy might have been prevented?—For a certain time.

7075. Do you think it would not altogether?—Possibly not; I should not like to venture upon an absolute opinion of that kind. I have no means of knowing.

7076. You have expressed a strong opinion in reference to the value of milk?—Yes.

7077. Have you any reason to believe that it is a decidedly antiscorbutic article of dietary?—I do think so; I always gave it on board the "Dreadnought," and saw excellent effects from it.

7078. Have you an equally high opinion in reference to eggs?—I have not the same experience of eggs, but I should think not, I have not observed that point.

7079. I presume that in connection with the "Dreadnought" you saw a large number of cases of scurvy?—A considerable number, twenty or thirty a year at any rate, and I was there fifteen years nearly.

7080. And where did these cases chiefly come from?—We drew out in a table all the ports from which we had the greatest number, and the Liverpool ships were about the worst at that time, or supplied the greatest number. Hamburg ships, especially, were on our black-list, and those were the principal; and then Shanghai, Calcutta, Bombay, Kurrachee, and the Mauritius; long voyages, of course, that meant, as a rule.

7081. Did you notice whether there was any con-

nection between the severity of a case of scurvy, and the duration of the period during which it had not been under proper treatment?—I do not think I have any precise observations upon that point.

7082. What was your treatment, usually?—Absolute rest is a very essential point. Then the dietary was milk, fresh potatoes, soup with vegetables in it; they could not eat very well, of course, solid food at once, they ate soup with vegetables boiled in it, and I always used to add oranges and watercress, whatever there might be about in the way of vegetables and fresh fruit. As to the relative value of eggs compared with milk, I might, on general theoretical grounds, say that eggs are not at all likely to be so valuable as milk. The experience of milk is that it is a production of vegetable-eating animals, that is as used by human beings; the milk we use all comes from vegetable-eating animals. Children at the breast are fed upon nothing else, and they thrive for a year or more. The conditions of an egg are somewhat different, especially if cooked. I should not place the same reliance upon eggs.

7083. Did you, when connected with the "Dreadnought," pay much attention to the ventilation of ships?—It was well cared for, and the ventilation there was very good.

7084. Do you think it would be an advantage that ships employed in arctic work should be ventilated by heated fresh air?—It would be an admirable thing if it could be carried out well.

7085. Did you observe any differences in the symptoms of your cases of scurvy according to the locality from which the cases came?—No; the only difference was the severity in some cases. The stage at which it may have arrived may have differed, but it was the same disease.

7086. You have not met, I think you have told us already, with any instances of scurvy in which there was not a defect of fresh vegetable food?—I know of no such case.

7087. Do you know if there may not, however, be a defect of fresh vegetable food without the occurrence of scurvy?—I can hardly answer that question in the absolute negative, but I think sooner or later scurvy will occur; it is a question of time very much.

7088. We have heard of immense quantities of fresh meat and fish being consumed in the Arctic regions for several months without any fresh vegetable food, and without any scurvy. If the statements are true, can you give us any explanation of the occurrence?—I should require very strong evidence indeed of the absence of all vegetable food.

7089. You mean fresh vegetable food, I have no doubt. There was evidence of flour and things of that sort?—Yes, I mean fresh vegetable food.

7090. You have not had occasion to examine into evidence of that sort?—No, I have not, but it is so totally at variance with the history of scurvy as produced in all parts of the world in all times, and with every variety of circumstance, that I should hold my mind quite open to doubt on that point.

7091. You think that all the facts might not be known?—Just so.

7092. Have you considered the subject, in reference to the recent expedition, of the comparative immunity of the officers as contrasted with the men?—I have mentioned that the same comparative immunity occurs in the merchant ships: the officers come home free from scurvy when their men are suffering from it, and the difference is explained by their having various luxuries in the way of fresh food that the men do not enjoy.

7093. That you think is enough to account for the difference?—Quite.

7094. Has the fact struck you, in connection with the recent expedition, that the number of cases from among the men wintering in the "Discovery," was very much less than from among the men wintering in the "Alert," although their dietaries were to all

intentions and purposes the same?—My impression was that hardly any scurvy broke out among the men living on board the ship.

7095. No; but I refer to the deteriorating effects of the confinement on board ship?—Among the men attached to sledging parties, the one ship suffered more than the other, as I understand you. I should say their health was more broken down by deteriorating circumstances first.

7096. You have not been able to find what these circumstances were?—No; I did not, perhaps, closely follow that point.

7097. (*Dr. Donnet.*) Among the examples which you have given of outbreaks of scurvy, can you afford any account of an outbreak in the Royal Navy, besides that which you mentioned among the men landed in the Crimea?—Yes, there was one, the history of which I had from an intimate friend of mine who had been a surgeon in the navy in South America, at Monte Video or Buenos Ayres, in September, 1845. The crew till then had been free from scurvy, and had been supplied with the usual rations of fresh beef and vegetables. After September, 1845, the supply of fresh meat was uncertain and scanty, and the supply of vegetables entirely ceased. Lime juice at this time was not supplied in any quantity to ships in the River Plate, because they always counted on getting vegetables. In November, that is two months after, scurvy appeared on board the ship, and one man died. Here, again, no officers suffered. In December vegetables, oranges, and fresh meat having been obtained, the scurvy disappeared. There was an interesting comparison side by side with that in a French ship which was engaged in the same expedition, which had no scurvy on board. Dr. Evans, my informant, attributes the difference to the Frenchmen having abundance of French wine and soft bread. They did not get vegetables, but French wine tided them over the difficulty. The officers of the British Fleet had wine and beer.

7098. This instance, therefore, confirms a general opinion that scurvy will only occur when fresh vegetable nutriment has been for some time partially or completely withheld?—Just so.

7099. The cases of scurvy which you observed whilst physician of the "Dreadnought," had come, I suppose, from various parts of the world?—All parts of the world, I should think, nearly.

7100. Have you had any experience with regard to the relative effects which cold and heat have upon the more or less rapid development of scurvy in men under the conditions required?—I could not say that, not from my own observation.

7101. Would you say that cold has a retarding or a hastening action towards developing scurvy under the admitted conditions?—I should say hastening.

7102. Do you think that hard work, cold, and absence of light will have any influence towards developing scurvy?—Yes.

7103. Have you had an opportunity of observing men who have been deprived for some length of time of the beneficial influence of the sun's rays, of which examples occur among printers, glass-blowers, and miners, and has not this absence proved detrimental to them?—I have not had the opportunity of making any minute or accurate observation. On general principles, you must, no doubt, say it has, but I cannot answer from personal observation. They all get a pallid look; I have noticed that their blood suffers from the want of red particles, just as it is observed in the reports here. It is reported by one of the commanding officers that the men all looked very pale and bleached after the winter. That occurs under all circumstances when men are long deprived of light; it indicates a degradation of the blood and a general impairment of nutrition.

7104. It will simply act, in your opinion, as a predisposing, not an exciting, cause?—Not an

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exciting cause alone. I may state that one of the conditions of scurvy is a great deterioration of the blood. The red globules, as they call them, the vivifying part of the blood, are deficient, and extremepallor of the tongue is one of the indications.

7105. Though the absence of light, impure air, the influence of cold, hard work, fatigue, and the almost entire absence of fresh meat, may not prove exciting causes towards producing scurvy, do they not, in your opinion, act as powerful predisposing causes?—Yes, I think so.

7106. And do you think, that had these predisposing causes been absent in the case of the late expedition, no scurvy would have occurred?—I do not think that the sledging parties would have had scurvy so soon. If you could have taken a crew of men from Portsmouth, or one of our English ports, and put them suddenly on a sledging party, they would have stood, I believe, two or three months, without scurvy.

7107. Had the ships wintered in a more southern latitude, do you think that the crews would have been better prepared for the sledge travelling?—I think so, to resist it longer.

7108. In the course of this inquiry it has been stated that the seeds of the disease were sown during the long and dreary winter months. Do you think from what you have learnt of the history of the outbreak, that there is any foundation for this assumption?—I took a special note of that; it struck me as a curious expression. If it is meant by that that scurvy is a disease like small-pox or scarlet fever, springing from germs, it is a pure theory, which we have nothing to support. Scurvy is a disease of a gradual breaking down of the nutritious qualities of the blood, the gradual result of the deprivation of vegetable food. You cannot talk of germs in a scientific point of view in reference to scurvy; so that if it is not a theory, it is a metaphor, and to be looked upon as nothing but a metaphor.

7109. My question, you think, then, implies a kind of incubation?—Incubation is also implied in the idea of germs. Degradation is the better mode of expressing it, I should say; gradually degrading and becoming more open to the attack when the causes are aggravated, and there is exposure and absence of vegetables. All this time there has been a comparative absence of vegetables, a degree of it that is undermining the system.

7110. With reference to the outbreak, was it, in your opinion, due to the sudden abstraction of the prophylactic, which, as we have had in evidence, had been conscientiously taken to the day of sledge travelling?—It was hastened by it, no doubt.

7111. May I ask whether, in your opinion, the lime juice acted in some measure as a stimulus, and by its action prevented scurvy from declaring itself in persons so conditioned?—I think that it acts in supplying a want of vegetable food.

7112. Would you liken it in its physiological action to the effects produced by the sudden abstraction of alcoholic stimulus in individuals accustomed to daily large quantities of this stimulus?—I know a good deal about that from having seen sailors in such circumstances, and I do not think they suffer from the abstraction of alcohol; they suffer more from going on with it. It used to be the practice with persons who drank freely to go on, as they say, with a "hair of the dog that bit them;" you could not suddenly leave it off, it was said, without endangering the occurrence of *delirium tremens*, and making them worse. But I think of late years the experience has been that the men are better by the total abstraction of the poison which has produced that state. That is my experience, except, perhaps, a very small quantity indeed now and then to prevent the sinking of the heart's action.

7113. The evidence which the history of scurvy affords, from its earliest description by Le Sieur de

Joinville, in the 13th century, in his history of the Crusade under St. Louis of France, to our time, confirms, I believe, the accepted theory of the present day, viz., "that scurvy will only appear under the condition of prolonged abstinence from succulent vegetables or fruits, or their preserved juices, as an article of food; while not a single instance can be cited of its occurring in a person well supplied with these vegetables or fruits." The evidence is so overwhelming in favour of this theory that I may almost say it has passed as an axiom in medicine; is not that so?—I accept that quite.

7114. I may likewise add that this theory has been confirmed by the medical evidence which has been afforded to the Committee; and from your answers to the questions put to you you have assisted in confirming the evidence already received. Am I right in saying so?—I concur in that.

7115. But in the relation of some of the arctic voyagers it is stated, that men have travelled over the arctic wastes for days and weeks, and in some instances for months together, during which their diet has consisted of meats, fresh in some instances, preserved and salted in others, and fish again in several, with no fresh vegetable food, nor its substitute lime juice, nor fir tops, and notwithstanding have enjoyed an entire immunity from scurvy. As examples of this we have had evidence before the Committee in the description of the two long and admirably conducted sledge journeys of Admiral Sir Leopold McClintock, of the sledge journey of Admiral Richards, and that afforded by Admiral Pullen in his boat expedition from Behring's Straits to the Mackenzie River and Cape Bathurst. These, you may say, are isolated facts, but to some minds they are startling ones, and as you have given much thought and care to the study and investigation of the history and causes of scurvy, I would wish you to favour the Committee with your opinions upon these seemingly contradictory exemptions, and throw such light upon them as may assist in dissipating any doubts which now obtain regarding them?—It is impossible or difficult to doubt the evidence of those who are in a position to know all these facts. I know Admiral McClintock too well to doubt that he is both truthful and accurate, but I am unable to explain those facts; but at the same time I should not accept them as evidence in the slightest degree counteracting the long history we have of scurvy through centuries, under every variety of circumstances, in which we universally find, wherever we see very much of it, that there is an absence of vegetables at the bottom of every outbreak of scurvy. The rule is too general to be impaired in any essential way by even those apparent exceptions. We have cases (I am not for a moment drawing an improper comparison) well attested, it is said, of girls living two or three years without food at all. That is so totally against the experience of mankind, that we do not believe it; we do not accept those facts. There is some explanation behind which we cannot, perhaps, get at; and so I presume there is here.

7116. I have laid these facts before you, because they have struck several persons as being very startling ones?—Yes.

7117. (Admiral Sir R. Collinson.) We have it on record that a case of scurvy broke out on board the "Discovery" before the people started on the sledge expeditions, and also that four other cases occurred to men who, from all that we hear, were in the habit of taking their lime juice regularly, on board both the "Discovery" and the "Alert," and were not exposed to the hardships of sledge travelling. Would you favour the Committee with your impression as to the cause of its outbreak?—There I should say that the resisting power of individuals will vary; some will break down earlier than others; and it is in accordance with what I have said before, that this

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dietary, although generally sufficient for a time, becomes insufficient relatively after a length of time, and just at that particular time two or three individuals break down who are not sufficiently protected. That simply bears out what I said, that the power of resistance is relative.

7118. If you had to prescribe a diet for future expeditions, you would probably suggest an increased issue of vegetables after six months in the ice?—That is so.

7119. Taking that matter into consideration, do you think that it was a judicious thing of Captain Nares to issue a double allowance of lime juice for a month before the people started?—I should say it was a most judicious thing to do. I did not note the fact myself, but I was very glad to hear of it.

7120. (*Admiral Inglefield.*) Are you aware of an extraordinary drift of nineteen individuals from latitude $78^{\circ}48'$ to about 53° north, who were six months upon the ice without any other preserved food but pemmican and biscuit; in that party there was a child at the breast, two women and three children, and the rest were the sailors of the "Polaris" expedition; during the whole of that drift they had nothing but the food I have mentioned, and seals' and bears' and walrus flesh to eat; and yet no symptom of scurvy broke out among them?—How did they start; did they start after exposure?

7121. They had spent one winter at Polaris Bay, therefore they were exactly under the condition of the "Discovery's" men, and in a vessel fitted out without any of the modern appliances which were supplied to the recent arctic expedition?—Then I should consider that in the same light as I should other exceptional cases; that there is some explanation behind which I am not prepared to answer upon. But I should not regard that as a trustworthy evidence that we can dispense with vegetables or lime juice with impunity.

7122. I wish to bring you to this point, that it has been given in evidence, or suggested to the Committee, that the action of cooking meat deprives it of some of its juices, which are antiscorbutic. Now, these people were obliged to live upon food that was eaten raw. Do you think we may attribute anything to that?—I should think there is something in that.

7123. Moreover, we have information of other expeditions in which men spent long months during the winter swallowing frozen flesh, and they escaped scurvy. Are these instances that you think are worthy of note?—I think that they are of the highest importance. I should like to institute further inquiries and further experiments upon that point. I can understand that there is some antiscorbutic virtue lost in the act of cooking. It coagulates the albumen, which probably is connected with the virtues that are antiscorbutic.

7124. A part of the same question is involved in the fact that whilst we have had in evidence that in all the arctic expeditions when the men have had plenty of exercise, and during the winter were well trained, there were less scorbutic symptoms than if the men were allowed to coddle themselves up. The extraordinary part of this very drift that I am speaking of is that the men had little or no exercise, and yet were not attacked with scurvy. So that it goes mainly to show that there must have been something peculiar in the diet that was antiscorbutic. They had no preserved potatoes, simply pemmican and biscuit?—That is an important case requiring further consideration and observation and experiment. I think the evidence of Captain Hamilton bore upon a similar point, but it appeared to me that he broke down when it came to the inquiry about the absence of vegetables. He was the gentleman whose note I took about the "germs sown and sprouting." I say that that is a metaphor. But he seems to have broken down as to his facts. Although his party

had not lime juice, he admits that they had potatoes and other vegetables.

7125. That is during a Government expedition, but I refer to the recent work of Hall's expedition in the "Polaris," to this very position in Smith's Sound where these ships wintered, and the circumstances are so far parallel that the ship had spent one winter in the same latitude as the "Discovery," and then occurred this six months' drift upon the floe, the men feeding upon raw flesh, and having nothing but pemmican and biscuits in the shape of preserved food?—That is an extremely important fact to bear in mind.

7126. I have carefully gone through the whole record, and there does not appear to be a single case of a symptom, even of swellings?—We have no other experience that I know hardly, of people living for a length of time on raw flesh. I do not know how it is in the savage tribes, but I suppose they generally get vegetables.

7127. You mentioned the instance of the "Gorgon," in 1845. I was out there at the time, and had some instances of scurvy on board the ship I commanded. Do you remember the particular case in the "Gorgon," where the man died?—One man died, as mentioned in the report before me; he died of effusion in the pleura and the pericardium, which is one of the not uncommon consequences of scurvy I have seen on board the "Dreadnought."

7128. It was off Monte Video?—They went up the Parana.

7129. Did the man die up the Parana?—I suppose he died in November, from the history here. The exact place is not mentioned.

7130. Has there occurred to you at all the possibility of concentrating lime juice, so as to make it more portable?—I have been thinking about that. Of course I have no chemical experiments upon the matter, but I can understand that it admits of a certain amount of concentration without impairing its antiscorbutic properties, in the same way as is done with potatoes and milk.

7131. That is a specimen of the lozenges (*handing one to the witness*); each lozenge contains a quarter of an ounce of concentrated lime juice, so that four of those would go to a man's ration on board ship (*the witness tasted it*)?—I should not mind being put on that diet; it is a very pleasant preparation, I think. It would be extremely imprudent in me to offer an opinion which would in any way help to subject men to the experiment. It might be made independently some other way. As far as I can tell from the taste, that is very good. I should say that the virtue there is retained, without committing myself to an absolute opinion upon the question. If there is too much heat, I can understand that the antiscorbutic virtue would be impaired on the same principle that we were speaking about in reference to raw meat. It should be done very gradually; draw off the water, and then get simply a concentration of it.

7132. Have you formed any opinion as to the age that men should be who are engaged upon arctic expeditions, the limit of the maximum and minimum?—The officers in the navy are far better qualified to speak upon that point.

7133. I will put the question in another way; do you consider that at a certain age men are more or less susceptible to attacks of scurvy?—I should say that the more feeble they are, the more susceptible they are.

7134. At what point in a man's age do you consider that the man's constitution is so well formed that he is better fitted to meet the arduous work of an arctic expedition?—I should not select men voluntarily under 27 or 28 years of age.

7135. In fact, you consider that at that age their constitution is better formed, and they are more able to resist the attacks of scurvy, or any other disease?—Yes.

7136. Do you consider that uncooked potatoes are

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more suitable for arctic service than these Edwards's preserved potatoes, because the custom in America is to slice potatoes and put them in molasses, and issue them to the men?—I have no experience on that point, but I should say that it is a thing well worth trying. I should think they would be more antiscorbutic in that form than after cooking or preserving.

7137. Then, finally, do you consider that on any arctic sledging journeys it would be expedient, if not essential, to carry lime juice as a daily ration?—Yes, decidedly.

7138. And in what quantity would you say?—An equivalent of not less than an ounce and a half a day.

7139. The usual ship's ration being one ounce?—Quite so, that is not enough.

7140. It should be increased, in fact, you think?—Yes.

7141. Is there anything else which suggests itself to you with regard to the cause of the outbreak of scurvy in the recent arctic expedition?—No, I think not.

7142. (*The Chairman.*) We have it in evidence from a medical gentleman, who appears to have paid considerable attention to the subject, that if lozenges of a description similar to those which you have just tasted, were supplied, it would not be safe to trust to them, unless they had been tried upon a very large scale, say, half a ship's company being put for a considerable time upon lime juice, and half upon the lozenges; what do you say to that?—I quite concur in that. I think that a sailor is far too valuable a person to risk an experiment upon. I would try it well first before I trusted to it.

7143. Notwithstanding that the chemical analysis of the prepared lozenge might have been very favourable?—Quite so. I should never trust to a chemical opinion upon the matter; it is a question of experience and experiment upon the person who is to eat or drink it; the stomach is the proper test.

7144. I understand that scurvy is a blood disease, caused by a deficiency of fresh vegetable food?—Yes.

7145. And that cold, fatigue, malaria, syphilis, &c., may aggravate the malady, but cannot alone produce it?—Yes.

7146. That fresh vegetables and fruit prevent scurvy, and also alone can cure it?—Yes.

7147. Assuming that a daily allowance of lime juice, such as you have recommended, could have been administered to the sledge parties, are you of opinion that the outbreak of scurvy would have been delayed?—Certainly.

7148. Are you further of opinion, that it might, or would, have been averted altogether?—Upon that I could not offer a positive opinion; and that must be taken with reference to the question asked me by Admiral Inglefield as to raw meat. I think that the effect of raw meat might be inquired into further; there is the possibility that fresh raw meat might be an equivalent for the absence of vegetable food.

7149. We have it further in evidence, that in previous arctic expeditions, under the more favourable circumstances of a lower latitude, and consequently, a shorter period of darkness, they were enabled to afford their sledge crews a considerable period of exercise and training, which the recent arctic expedition, from the circumstances in which they were placed, were unable to do. Should you consider that as a circumstance likely to have induced the speedy outbreak of scurvy?—I should say that the training was an advantage.

7150. (*Dr. Fraser.*) Have you any opinion as to what constituents of lime juice possess the power of warding off and curing scurvy?—I believe it is the natural combination of all the constituents that its virtue depends upon. I should have no faith in any chemical extract of a portion of it.

7151. You do not think the water essential, do you?—The water is not essential.

7152. And these extracts may be valuable?—These extracts may be valuable; that is a matter for observation and experiment.

7153. I dare say I am right in saying that the chief constituents in lime juice, putting aside the water, are the citric acid, the malic acid, and possibly a small quantity of tartaric acid, and potassium and other salts?—As far as chemistry tells us, that is correct, I believe.

7154. Can you tell us with which of these constituents experiments have been made in order to determine the question?—They have been made with citric acid. I am not aware of any experiment with malic acid. Citric acid alone will not do; it has not the virtue of lime juice.

7155. Are you aware of experiments having been made with any potash compound?—Yes, it has been made, and that also breaks down. I think that theory is totally unsupported by sufficient evidence.

7156. You think there is no evidence in favour of potash being the active substance?—I know of none.

7157. Are you of opinion that there is also no evidence in favour of citric acid?—I can say, with some confidence, that I think it is not effective.

7158. May we ask to what data you refer?—We have given it on board the "Dreadnought." But the observations on board the "Dreadnought" are open to this fallacy, that we have never relied on one thing alone; we were not justified in trying experiments; our duty was to cure the men suffering *cito et tuto*, as quick as we could. Therefore they had milk and fresh vegetables, and various things, but sometimes they had citric acid without the lime juice, and we thought that they did not get on so well; that is not an absolute test.

7159. And that is restricted to the curative power, it has nothing to do with the preventive power?—No.

7160. Of course you are perfectly aware of Dr. Trotter's and Sir William Burnett's somewhat extended experiments on that subject?—I have heard of them.

7161. Can you form any opinion with regard to them?—No.

7162. Do you know that, chiefly basing his opinion on these experiments, the late Professor Parkes was of opinion that citric acid is a valuable antiscorbutic?—It may be of some value, the same as vinegar is sometimes, but I cannot admit that it is an efficient substitute for lime juice.

7163. Not so good as lime juice?—No. I may say that Dr. Grant, whom I know, at Ottawa in Canada, describes an epidemic among the lumber men there; it broke out in the absence of vegetables. He made this observation, that the disease in great measure was due to the free use of nitrate of potash in salting their meat. So you see it broke out in spite of potash.

7164. (*Admiral Inglefield.*) Did you see any difference in the symptoms on board the "Dreadnought" amongst men who had been in a tropical climate and men who had served in a cold climate?—No; it was one disease.

7165. The symptoms were always alike?—Yes.

The witness withdrew.

Adjourned to to-morrow, at 11 o'clock.

TUESDAY, 30TH JANUARY, 1877.

PRESENT:

ADMIRAL SIR JAMES HOPE, G.C.B., in the Chair.

ADMIRAL SIR R. COLLINSON, K.C.B.

VICE-ADMIRAL E. A. INGLEDEN, C.B., F.R.S.

JAMES J. L. DONNET, ESQ., M.D., Inspector-General of Hospitals and Fleets, R.N.

THOMAS R. FRASER, ESQ., M.D., F.R.S.E.

H. J. VANSITTART NEALE, ESQ., Secretary.

MR. ALEXANDER GRAY, *examined*.

7166. (*The Chairman*.) In what Government arctic expeditions have you been engaged?—None but this last one.

7167. In what capacity did you serve in that expedition?—As Ice-quartermaster.

7168. What had been your previous calling?—I was employed in a whaler in the arctic seas as a harpooner.

7169. For what number of years?—In 1863 was my first year as a harpooner. I went to the whaling trade in the arctic regions, Greenland and Davis' Straits, in 1852.

7170. Between 1852 and 1863 how were you employed?—First as line-coiler, and then a few years after being line-coiler I was boat-steerer, and I was just promoted up till I got to a harpooneer.

7171. (*Admiral Inglefield*.) You had been twenty-three years, then, in the whaling business before you went on the recent expedition. Then you have only wintered once in the arctic regions before this last voyage?—Yes; I had wintered in Cumberland Gulf four different times before I went in the expedition.

7172. Then you have served four winters in the arctic regions, and 23 years in voyages to those seas?—Yes.

7173. With that experience I daresay you have seen scurvy amongst the men on board whalers?—Yes, during the winter season.

7174. In what ships?—The last ship I was wintering in was the *Lord Saltoun* of Peterhead.

7175. How many cases of scurvy were there then?—There were very few cases that year; there were three aboard of our vessel, and a good many aboard of the American vessels.

7176. How were the men treated for scurvy upon those occasions?—The captain used to give us the preserved vegetables, like as turnips and carrots, and fresh meat and lime juice likewise.

7177. And did the men recover?—Yes.

7178. You never had a man die?—No, not that time that I was going, but there were five men laid in one grave from the "*Alibi*," a ship out of Aberdeen, with the scurvy.

7179. What year was that?—In 1857 or 1858.

7180. Was there any doctor on board that ship?—No, there was no doctor that year.

7181. Then the men were treated for the scurvy by the captain?—Yes.

7182. Did they die during the winter?—In the winter season, towards the commencement of the spring.

7183. Those men had not very hard work, had they?—No.

7184. It was simply the scurvy; and the men when they got the scurvy laid by and were physicked by the doctor, was that it?—They were tended by the captain; we had no doctor.

7185. Was there no doctor in any other ship that was able to attend them?—No; they carry so few hands that the Act does not require them to carry a doctor.

7186. But most whaling ships do carry a doctor, do they not?—When they were coming home they would carry about 50 or 60 hands, and then they would carry a doctor.

7187. Do they take a doctor out to the arctic regions?—Yes. Mr. A. Gray.

7188. Why does not the doctor remain in the ship?—He does remain in the ship, but not in the wintering. 30 Jan., 1877.

7189. Did those vessels go out with the intention of wintering, or were they caught?—With the intention to winter.

7190. Why did they intend to winter?—To catch the early fishing.

7191. And to get young seals?—No; to catch the whales.

7192. Is it the case that when the ship remains they leave only a few hands in her, and the doctor goes home?—No; they carry no doctor in the wintering ships.

7193. You saw five men die in one ship, I think you say?—Yes, belonging to the "*Alibi*."

7194. Have you ever seen other men die of scurvy?—No, none but those two men belonging to our own expedition; but that is quite a different scurvy altogether from that they have in winter in the whalers.

7195. What is the difference between the scurvy that the men died of in the "*Alibi*," and what you saw in the Government expedition?—To explain it to you, that scurvy attacked them, because the men were lying and rolling about during the winter upon their chests: the difference was so great when they were taken out to hard and severe work and exposure to the atmosphere.

7196. Were the symptoms the same in both which appeared, namely, blotches on the skin and swollen gums?—No, it did not appear like the same as with our hands.

7197. Will you describe what the whalers' symptoms were when a man began to feel ill; what did he complain of?—His joints and his legs got all black and soft like putty, so that you could leave the mark of your finger in them.

7198. And had he black spots upon his body; and were his gums swollen; did his teeth get loose, and the gums bleed; that is the sort of scurvy that the men had in the Government expedition?—It came out more of a pink colour than ever I saw any scurvy before.

7199. Have you ever seen the Esquimaux with scurvy in the neighbourhood where your ship wintered?—No; not with scurvy.

7200. What sort of provisions did they give you in those merchant ships?—We often ate preserved meat; but the Esquimaux had seal meat, and we had some from them.

7201. Did the men like seal meat better than preserved meat?—Yes, a good few of them did, but some of them could not eat it.

7202. You were much better fed in the Government arctic expedition than in the merchant ships, were you not?—Yes, a great deal better.

7203. Therefore, there was more chance of the men having scurvy in the merchant ships than in men-of-war?—Yes; decidedly so; there were thousands of chances more.

7204. Did you ever hear any talk on the lower deck of the ship you were on board of as to the quality of the provisions, whether there were some of them not so good as the other; for instance, did you hear any

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talk on the lower deck of the "Discovery" that the beef was very salt?—I have heard them passing the remark about the salt meat, that it was rather salt.

7205. And not so good as some other beef that you have had in other ships?—No; I have heard them passing that remark. Of course, it was my first voyage in the navy, and I was no judge myself.

7206. Did the men ever complain, or did you hear them complain, about the wet on the lower deck from the condensation upon the beams dropping upon their beds?—I have heard them complain among themselves about it.

7207. Was there a great deal of moisture that fell upon their hammocks?—No; not extraordinarily much.

7208. More than used to be the case in your merchant ships?—Yes; when it came soft weather.

7209. Did you drink your allowance of lime juice always in the "Discovery"?—Yes.

7210. Did all the men take their allowance, do you remember?—Every one took his allowance.

7211. And liked it?—Yes; some would have taken more than the allowance, in fact.

7212. You were once travelling with a sledge?—Yes.

7213. Were you upon the extreme northern journey?—No; upon the north-eastern journey.

7214. And you were one of the men that was last to be taken ill, were you not?—Yes.

7215. You did have scurvy a little, did you not?—Yes, in one leg.

7216. Do you remember whether the men liked tea or rum best when they were travelling; which seemed to do them most good?—I think they liked their allowance of rum. They used to get it at night after they knocked off, but they would prefer it at lunch time mixed with their tea; they found that it did them most good then.

7217. But it was issued to them when they turned into their bags?—Yes.

7218. How far north have you ever wintered before you served in the "Discovery"?—In Cumberland Sound, in about 68° north latitude.

7219. Did the scurvy that you had last long; how long were you ill with it?—I was all right in 15 days at the outside. I was fit for work then.

7220. Did you ever have any sledge journeying when you were in the merchant service?—Yes.

7221. What did you journey with sledges then for?—Carrying whale blubber.

7222. Why had you to carry whale blubber?—To take into the land and to save it from going away with the ice.

7223. You have wintered on board your ship, I believe?—Yes.

7224. When you caught a whale you carried the blubber on shore to the land across the ice?—Yes; to the nearest land.

7225. What did you do with it there?—Put it into casks.

7226. Ready, I suppose, to take it on board when the summer months came?—Just so.

7227. So that you have had sledging in the merchant service as well as in the Government expedition?—Yes.

7228. What weight did the men carry on the sledge in the merchant service?—We never took the weight of what we put on, but we just put on as much as we thought we could drag.

7229. How far would your sledge journey be?—We would have to go three or four miles, continuing the whole day backward and forward.

7230. Was that on smooth ice?—No; there was a good deal of wet snow at times.

7231. Did you have to drag your sledge through the wet snow?—Yes.

7232. Then that was quite as hard work as sledging in the "Discovery"?—It was as hard work, but we were not so continually at it in the merchant service.

7233. And then you were only three miles from your ship, so that the sledge party was brought on

board in the night?—No; we slept on the floe; we were further than that from the ship. This was only taking blubber to the nearest land to save it in case of the ice breaking up.

7234. Did you keep it in a cask on the nearest land ready to take on board, so that you had to sledge around this rough ice covered with snow to get it to the land, and to deposit it?—Yes.

7235. And sometimes you had to sleep upon the floe?—Yes.

7236. Often?—Not often, because we used to take the land for that, when we got a chance.

7237. What time of the year would that be?—We would start about the last day of April; sometime about the 10th of April to the 5th of May.

7238. When you slept upon the floe, did you have tents?—Yes.

7239. What sort of tents were they?—They were made of thin canvas.

7240. What did you eat; did you cook your food there?—Yes.

7241. What sort of stoves had you for it?—We had just something similar to the cooking apparatus used in the recent arctic expedition. We used blubber for the fuel.

7242. Did the crew suffer much from sleeping out in that way?—No.

7243. It was mild weather then, was it not?—Yes, it was mild weather; and then it was so far south, too.

7244. Did you ever use dogs in your sledges?—Yes, we used dogs, too.

7245. Did the Esquimaux help you?—Yes.

7246. Then I gather, from what you have told me, that you had some experience in arctic sledging, in wintering, and in voyaging on previous expeditions, before you went upon the last one?—Yes.

7247. And that you never had scurvy until you went on this last expedition?—No, never.

7248. To what cause do you attribute your getting the scurvy this last time, seeing that you never had it before?—My idea is, that it was just the hard work, and being too long upon one kind of food.

7249. Do you mean too much pemmican, and too much biscuit, and that kind of thing?—Yes; instead of having a change.

7250. If you could have had a greater change, you do not think that you would have had the scurvy?—No, I do not think we should; I am certain of that fact.

7251. In those merchant ships did you have much greater change?—Yes; we had a change mostly every other day; two or three times a week.

7252. What other kinds of diet did you have in the merchant service that you had not got in the last expedition?—We had nothing different to what we had in this last expedition, but we changed it oftener. We were nearer handy to the ship, and we could get it from the ship with little trouble: that is where it is.

7253. (*Dr. Fraser.*) You were asked whether you were fed rather better in the Government ship "Discovery" than you had been in the whalers?—Yes, we were.

7254. Were you fed better in any one of the whalers than in any other, or was it about the same in all?—About the same all through.

7255. What did you generally get to eat in the whalers?—We had soup one day, and in the soup there was preserved carrots and turnips; and some captains give us a tin of preserved meat to put in amongst it; but others do not. Then there is duff and fresh beef perhaps the next day, and no vegetables that day. You have vegetables three times a week, and you have potatoes twice a week.

7256. How much potatoes did you have?—They are whole potatoes, and not preserved potatoes.

7257. Did those whole potatoes last the whole of the winter?—No; we used to get them as long as they lasted in the wintering ships, and then we ate preserved potatoes.

7258. How long did the whole potatoes generally

last?—They lasted till about the last of November, it may be longer, and then we took to the preserved potatoes.

7259. How often did you get these in the week?—Twice a week.

7260. Were they Edwards's preserved potatoes?—Yes.

7261. How much did you get of the preserved potatoes?—I can hardly describe the allowance.

7262. Did you get a good mess?—Yes.

7263. Nearly as much as you would take at once?—Yes, as much as I could take at once.

7264. Did you eat it all?—Sometimes we did, and sometimes we did not.

7265. Had you sometimes more potatoes than you could eat?—Yes.

7266. Did you get more or less preserved potatoes in the whalers than you got in Her Majesty's ship?—You got more in Her Majesty's ship.

7267. Were you sometimes unable to eat all the potatoes that you got in Her Majesty's ship?—Yes; sometimes we could not eat them all.

7268. Can you tell me of anything more that you had to eat in the whalers?—No, nothing more of any importance, except bits of seal meat that we used to get from the natives; that was all the fresh meat that we got.

7269. Did you eat whale?—Sometimes we ate the black skin.

7270. That is very good, is it not?—Very good. I was once fifteen days upon that, and nothing else.

7271. What did it taste like?—Just like periwinkles.

7272. (*Admiral Inglefield.*) Did not you have the white whale, which is much tenderer?—Yes, we did sometimes.

7273. (*Dr. Fraser.*) How do you cook the whale skin?—We commonly boil it about twenty minutes, and then take a little vinegar to it, and pepper, and it is very good. We termed it a "treat" to ourselves.

7274. Were the seals very good too?—Yes.

7275. Did you fry or roast them?—Sometimes we fried them, sometimes we baked them, and sometimes we boiled them.

7276. With potatoes or vegetables?—Yes.

7277. Did you eat the blubber of the whale at all?—No.

7278. You did not like it?—No.

7279. You say you lived for fifteen days on the skin of the whale; where was that?—In Cumberland Gulf.

7280. Were you alone?—No, we got on to the pack ice. The ice was broken up, and we were driven up the gulf on the pack, with a whale that we had killed.

7281. How many of you were there?—There were two boats' crews of us, twelve of us altogether.

7282. Had you no other provision but this whale?—Nothing but tea.

7283. Had you no rum?—No; no spirits.

7284. When did you commence to use lime juice in the whalers; how soon after leaving the country?—I think it is twenty-nine days after we leave port.

7285. Did you ever commence it before the round potatoes were finished?—Yes.

7286. How much did you get?—One of those bottles would last a man thirty days.

7287. How much would each man take; was it measured in any way?—No; in some ships it is measured out, but it is not always convenient for the captain and the steward to get the day's rations served out every day, because they will be either whaling or sealing, or something or other that turns up.

7288. You sometimes got a bottle which lasted you thirty days, how did you take it each day?—With a little sugar and water.

7289. How much did you put into the water, do you remember?—Scarcely half-a-gill.

7290. What did you measure it in?—We just poured it out by guess, and guessed about half-a-gill.

7291. Did you like it?—Yes, very well.

7292. Is it generally liked?—Yes; it is liked where

you come to hard work, for drinking. Some of them will drink a bottle-full in three or four days.

7293. What did they do for more after that was done?—We would get it from some of the rest of the men.

7294. You never found any man who did not like it, did you?—Yes, some parties did not care about it.

7295. Is that common, or not?—That is not common.

7296. Did you ever know of men throwing it away?—No, I never knew of any person throwing it away.

7297. If they did not wish for it, some one else would be only too glad to get it?—Yes, some one else would have drank it.

7298. Did you get any lime juice in the "Alibi"?—No, I was not in the "Alibi" that year; I was only wintering there that season.

7299. You do not know what they had to eat on board the "Alibi"?—The men were telling me that it was very salt meat that they had; they had very little fresh meat on board the "Alibi."

7300. Had they any vegetables?—I do not think so.

7301. Do you know?—No, I do not know; no further than the ship's company telling me.

7302. Then they told you that they had no vegetables, did they?—Yes.

7303. Had they lime juice, do you know?—I do not think that they had any lime juice.

7304. Were they British ships or American?—They belonged to Aberdeen.

7305. In all these whalers that you have been in you had lots of vegetables, and quite a sufficiency of lime juice?—Yes.

7306. You were in the "Discovery," I think?—Yes.

7307. Had you any post on board ship; were you a petty officer?—Yes, I was ice quartermaster.

7308. What were your duties as ice quartermaster; what was your work?—Going to the bridge and going to the mast-head, and looking for a passage through the ice.

7309. You had not charge of any mess, or anything of that sort, had you?—No.

7310. Did you become very tired of the long winter in the "Discovery"?—No; I enjoyed myself, and was very happy.

7311. Then you had seen winters there before?—Yes.

7312. And as long a darkness?—No, not darkness; I had had no darkness before.

7313. This was the first season that you had such darkness?—Yes, the first season I had such darkness.

7314. Then you did not dislike it much?—No, I did not; I cannot say that I disliked it, for I was very happy all the winter.

7315. I suppose the men generally were very happy?—Yes.

7316. Had they plenty to do?—Yes, we were very happy amongst ourselves, too; and there was not extraordinary heavy work, but just enough to keep us employed, and we had plenty of amusement.

7317. What did you think of the sleeping quarters compared with those in the whalers; had you more or less room, or were they more or less comfortable?—We had more comfort on board the "Discovery" than in any whaler; we had more room.

7318. In the whalers, did you ever spend so much of the daytime, when you were not in your hammocks, between decks, as you did in the "Discovery"?—Sometimes the men spent the whole day between decks, in the whaler; some would not come out.

7319. They were loafers, do you mean?—Yes; and those that did not come out began to feel it in their joints in the spring.

7320. Was the main deck sufficiently warm, do you think?—Yes, comfortably warm.

7321. Was it ever too warm?—No, it was not too warm, there was just a nice heat in it. I have been comfortable enough coming off the deck from the middle watch, at 4 o'clock in the morning, turning into my hammock without any fire or anything.

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7322. When you came from the outside into the deck, did you ever feel it stuffy?—No.

7323. Was it more damp on the deck of the "Discovery" than in the whalers, or which was the more wet?—I have seen as much wet in whalers, if not more.

7324. You think that there was no extraordinary amount of dampness in the "Discovery"?—No; it was not extraordinarily wet; it was wet, but not extraordinarily wet.

7325. When did you see that wetness chiefly; was it all day long, or all night, or when?—All day, the most.

7326. What did you see?—Dropping off the beams.

7327. Did it drop into your hammock?—Yes. Once the cooking fire went out at night, and it did not drop any more.

7328. It became colder, you mean?—Yes.

7329. Then, when the fire was lit again, I suppose it would drop all the more afterwards?—Yes; it dropped towards the forenoon, at the time of cooking the dinner, owing to the steam and one thing and another.

7330. Before the fire went out, did it drop into the hammocks?—The hammocks were never taken down till the fire was out.

7331. Did it drop into the hammocks when you were in them?—Sometimes; but we covered them up.

7332. You mean that you covered yourselves up?—Yes.

7333. Do you recollect what was done to get rid of the dampness?—Yes; the engineer made a concern to draw the steam off the lower deck; he made a funnel up through it that took a good deal of it off; they tried all means that they possibly could think about; in fact, they tried everything.

7334. What else did they do?—They lighted fires for it to dry up.

7335. Did not they have men wiping it?—Yes; there were always men wiping it.

7336. Night and day?—All day up to bedtime.

7337. What time did you breakfast?—Seven o'clock.

7338. What did you get for breakfast?—Cocoa and soft bread, and sometimes musk-ox meat and sometimes preserved meat; no salt meat; sometimes they would take a bit of it, but there was no salt meat used in our mess scarcely in the morning.

7339. What was the number of your mess?—No. 1.

7340. Were your appetites generally good at breakfast?—Yes.

7341. Did you get any vegetables at breakfast?—Anything that we saved from the dinner we should use the next morning, perhaps with a little potatoes warmed up.

7342. They were the potatoes that had been served out the previous day?—Yes.

7343. When did you dine?—Twelve o'clock.

7344. What did you have for dinner?—We would have changes; we would have mince-meat one day and hotch-potch another day and preserved meat another day, and so on.

7345. Did you have salt meat?—Only once a week, I think, we had salt meat.

7346. Did you like it?—No, I did not care much about it; I never cared much about salt provisions when I was out wintering before. I would rather take a piece of bread, and cocoa or tea, than take salt meat, for my part; but there is a good few that like it.

7347. It was served out, but you so much disliked it, that you would not eat it?—I would not eat it.

7348. Then you got no meat that day at dinner?—We would always have a piece of meat in the mess, and some days I would have a piece of salt pork with a few potatoes.

7349. Then you never were without meat at dinner?—No.

7350. Were there other men who did not like salt meat in your mess?—There was more that did not like it, and more that did not eat it.

7351. Then there must have been a large spare supply of other meat, surely; where did the other meat that you had come from?—We would not eat the day's allowance at one time, and we saved it.

7352. As a rule, when you had preserved meat did you not eat it all?—No, we did not eat it all some days.

7353. Was it generally too much?—Some days there was just sufficient, and other days rather much.

7354. More than you could eat?—It was just according to how you were exposed to the air, and how your appetite was.

7355. And when you had this preserved meat, I suppose there were vegetables mixed up with the meat?—Yes.

7356. Was the vegetable mixed up with all the meat that was cooked?—All the meat, except the preserved meat, and then we had pickles.

7357. Do you mean to say that on the days that you were served with preserved meat, you had no boiled vegetables?—Yes, we had vegetables that day, too.

7358. And then you had, in addition, pickles?—We had pickles, too.

7359. What vegetables did you get most of for dinner, taking the week round?—Carrots, I think it was, that we had most of.

7360. How often did you get carrots in the week?—Three times, I think, but I am not certain whether it was more, or not; it was nothing less.

7361. What vegetables had you next most of?—Hotch-potch; there was a lot of vegetables in that, turnips, and carrots, and green peas, and stuff like that.

7362. You liked that, did you?—Yes.

7363. How often had you potatoes?—Four times a week, I think.

7364. Then they were oftener served out than carrots?—Or it may be three times; I do not recollect exactly.

7365. Had you any other vegetables the same day as you had potatoes?—No, I do not think so; only potatoes.

7366. And those you had three or four times in the week, you say?—Yes.

7367. Did you like the taste of the potatoes?—Yes, I liked them very well.

7368. Were they as good as round potatoes?—No, they are not so nice as those, but they are a good substitute for round potatoes.

7369. Have they not quite the taste of round potatoes?—Not to my taste; there is less taste about them.

7370. You had a good lot of them, I think, had you not?—Yes.

7371. You had as much as you would eat at once of potatoes?—Yes.

7372. Did you eat it all?—Some days I would eat it all, and the next days I would not.

7373. What did you drink at dinner?—Grog; and the lime juice an hour before dinner time.

7374. What did you have after dinner?—Supper.

7375. That was at half-past 4, was it not?—Yes.

7376. What did you have for supper?—We had tea and bread, and sometimes, if a pie had been cooked for dinner that day with fresh meat, we had the remains of it for tea.

7377. You had no special vegetables, I suppose?—No, nothing but pickles; we used pickles at every meal mostly.

7378. You were very fond of pickles?—Yes.

7379. Sailors are always fond of pickles, are they not?—Yes.

7380. What kind of pickles did you get?—We had cabbage, and onions, and walnuts.

7381. That was all the food you had, I suppose, in the day?—Yes.

7382. If you were out all night, did you get anything to eat?—No; I never got anything when I was upon night watch; I never saw anything to eat. I came off my watch, and went away to my hammock at once.

7383. How long were you on watch?—Four hours.
7384. Did you like the lime juice that you got in the "Discovery"?—Yes, very well.

7385. Was it as good as what you used to get in the whalers?—Yes.

7386. Do you know the taste of it well?—Yes.

7387. I would like to ask you if you think that that tastes like lime juice (*handing to the witness a lozenge prepared by John Bell and Company of Oxford-street*)?—Yes; that tastes something like it; it is rather strong, stronger than we would drink it; but it has got the flavour of it.

7388. At what time was the lime juice served out in the "Discovery"?—About half past 11, or thereabouts, in the forenoon.

7389. Where was it served out?—On the lower deck, during the winter season.

7390. Who served it out?—The ship's steward and a petty officer.

7391. What was the name of the ship's steward and of the petty officer?—George Sara was the ship's steward, and George Emmerson was the petty officer, and some days there were others; there were the chief mates of the watch.

7392. Was Jenkins one?—Yes; he was one of the petty officers.

7393. Was the lime juice mixed at the tub?—Yes.

7394. That is to say, for each mess?—Every man got their allowance.

7395. What did they do with it?—Drank it.

7396. Did they drink it there before the officer?—Yes, some would have drunk two allowances if they could have had it.

7397. Were there two allowances for them?—No.

7398. Was it never taken with the grog?—No.

7399. Do you like it that way?—I just had it once that way, but I do not care much about it.

7400. Does it spoil the grog?—Yes.

7401. I suppose every man took his lime juice?—Every man.

7402. There had been a man ill during the winter, I think, of the name of Shepherd; do you remember him?—Yes.

7403. What was he employed at?—A cooper.

7404. What had he to do as cooper?—He went along with the ship's steward, and took the heads off the flour casks or beef casks, and he went down into the hold and measured up the provisions, and things like that.

7405. Was he a sort of under steward?—Yes.

7406. Was he working with the provisions sometimes when the steward was not there?—Yes, when the steward could not get to attend upon them.

7407. Did you know this man Shepherd well?—Yes.

7408. Did you know him before you went to the "Discovery"?—No, only on board.

7409. What was the matter with him when he first took ill, so far as you saw?—Scurvy, when I saw him first, but he was ill a few days before I knew of it.

7410. When do you remember seeing him first?—It was before Christmas; I took notice of him.

7411. He did not become ill till January, I believe?—But he was complaining about his legs before January.

7412. Did you ever hear that he was fond of his grog at any time?—I could say nothing about that, because I took no notice of people's affairs. I had enough to do to look after my own capacity.

7413. Did he appear to you to be a strong man?—No, he did not appear to me to be a strong man the first time that ever I saw him in Portsmouth.

7414. What did you think was wrong with him; what was likely to be the matter with him?—I think, from my idea, the man had been taking a drop during his younger days, rather heavy.

7415. You thought he looked like a man who had been injured by too much drink in his day?—Yes, that was the idea: I may be wrong.

7416. But that is what struck you?—Yes.

7417. You do not know if he drank on board; that

is, you never saw him the worse for it?—No, I could not say that I saw him the worse for it, but there was just once when he appeared to have been having a glass rather much.

7418. He might have taken as much as he liked, almost, might he not, from having command of the store?—No; the steward and the sergeant were there. The steward would have been in his office, and the spirit-room was just at his office door.

7419. Was he off work at all before this time that you saw him ill at Christmas?—No, he was not knocked off.

7420. Was he ailing?—Yes, he was complaining about one of his legs. He said that he fell down when he was on shore taking some provisions from the land to the ship.

7421. That was after going into winter quarters, was it not?—Yes.

7422. And that was before Christmas?—Yes.

7423. Was he laid up after that?—Yes, he was laid up after that.

7424. How did you know at that time that it was scurvy?—I saw his limb.

7425. What did you see in the limb?—It was getting yellow, and beginning to swell, and tight about his knee-joint.

7426. Was he complaining of his mouth then?—No; I did not examine anything about that, but I merely passed the remark, and said, "Jemmy, surely that is scurvy that you are taking."

7427. You had seen scurvy before, and you knew what scurvy was?—Yes; and our doctor found it out very quick after that.

7428. Did he look to you like a man who would not be fit to eat as much as was served out to the men?—Yes, he had all the appearance of that.

7429. He was not in your mess, I think?—No, he was in Jenkins's mess.

7430. This was the first case that you saw at all like scurvy until the spring?—Yes, that was the first case.

7431. Did you go to the "Alert"?—Yes.

7432. Then you went with Captain Markham, did you?—No; I went with Lieutenant Beaumont to north-east Greenland.

7433. You held out a long time, did you not, whilst the others were becoming ill?—Yes.

7434. Who was the first to take ill in that party? James Hand.

7435. How long after you started from the "Alert" was that?—I suppose from 12 to 15 days.

7436. Did you feel perfectly well before you left the "Discovery"?—Yes, in good health and good condition, fit for anything.

7437. The long winter did you no harm, so far as you know?—No harm whatever.

7438. So far as you know, were your party in good health?—They were all in good health when they left the ship; they had all the appearance of it.

7439. Judging from the manner in which they did their work, would you say that they were fit for anything?—Fit for anything.

7440. They did their work as well as you could possibly expect them to do it?—Yes.

7441. Had you charge of a sledge?—I was captain of Lieutenant Beaumont's sledge.

7442. And the men worked well, did they?—Yes, they wrought like men.

7443. None of them appeared at all to become weak?—No.

7444. And none of them complained of weakness?—No, none of them complained about the work, or weakness, or anything, till they began to get stiff in the joints and could not do their work.

7445. That was after Hand became ill?—Yes; Hand was the first to be seized in the joints.

7446. Until Hand was ill, there was not a complaint in your party?—No, no complaint at all.

7447. Not even of weakness?—No.

7448. Then from the first day of leaving the ship until Hand became ill, did you notice any distinct

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7449. Did you, on the first day you started, commence to eat pemmican and bacon and the ordinary sledge rations?—Yes; the very first day.

7450. You had a large quantity of pemmican, I think; did you eat it all at first?—Yes; we liked it all very well at first starting; in fact, it was very good, and I liked it very well.

7451. Were your appetites sufficiently good for you to eat the whole of it at first?—Yes; at first they did.

7452. Did your appetites continue good until Hand became ill?—Yes; the rest of the men's appetites continued good for a long time after.

7453. Until Hand became ill there was no leaving of portions of the ration?—No.

7454. Every one ate every part of it?—Yes.

7455. And their appetites seemed very good?—Yes.

7456. You liked the pemmican?—Yes; I liked it very well.

7457. Which kind did you like best?—The sweet.

7458. How was it cooked?—It was made into a soup, with potatoes and onion powder, and a little salt.

7459. Did the men prefer the pemmican to the potatoes; did they like the pemmican better than the potatoes?—No; they liked the potatoes done first and then put into the bottom of their dish, and then the pemmican above that.

7460. And you do not know, do you, of the men eating the pemmican and not eating all the potatoes; they always eat the potato, did they?—They always ate all the potato.

7461. The whole mess?—Yes.

7462. There was not so much potato, I think, as you had on board ship, was there?—No; we would not be fit to carry so much.

7463. Never mind that. I want to ask you whether there was so much potato served out at each ration while you were sledging as there had been on board ship?—No, I do not think there was.

7464. You could have eaten more potato, could you?—Yes; some would have eaten more, but I always had sufficient.

7465. Did you miss the lime juice?—Some days when we were working hard, we could have taken a drink of it pretty handy.

7466. You missed it, in fact?—Yes.

7467. At what time of the day did you take your dinner, your principal meal, I mean?—When we knocked off at night, six o'clock.

7468. It was at the end of the day's work?—Yes, it was at the end of the day's work that we took dinner.

7469. And while you were working you got tea, did you not?—Yes.

7470. How long did you halt for tea?—For an hour.

7471. Was that about the middle of the work?—Yes, the middle of the day.

7472. Did you like that halt?—We were often longing for the lunch time.

7473. And what had you for that lunch?—Tea, bacon, and biscuit.

7474. Was the bacon ever made larger in quantity in your party than when you first started?—At the latter end of the journey the men went away from eating the bacon.

7475. Were you generally thirsty?—Sometimes.

7476. Do you think you got enough to drink?—Yes.

7477. I mean water?—I understand what you mean.

7478. You got enough water?—Yes.

7479. Did you melt it easily?—We made always a drop of water in the morning when we were cooking the breakfast, and carried it in the bottles. The latter part coming home we did that, but it was no use to put it in the bottles going away, because of its freezing.

7480. Do you think if you had carried lime juice you could have thawed it at the same time as you thawed the water; tell me your own opinion about that; by putting it on the top of the cooking apparatus, say?—We would have thawed it at the same time, but then it would have stopped us getting water to mix among it.

7481. You could have thawed the lime juice, but you think you could not have thawed enough water to mix with it; that is what you mean?—Yes.

7482. Do you like lime juice in water?—Yes, I like it very well.

7483. Why could you not, if you had thawed the lime juice, have added it to the water which you had at any rate thawed and drunk them together; was there any difficulty in doing that. Would it have been a disagreeable mixture, or would it have been impossible to mix the two together and drink them?—You could have mixed them together and drunk it.

7484. Did you ever try it with tea?—Yes, I have tried it with tea and coffee, and taken lime juice as sugar to the coffee, before now.

7485. How did you like it?—I did not relish it. I used it a few days.

7486. Was it at all disgusting?—I did not care about it.

7487. But it was not disgusting?—No.

7488. You could have gone on for a month with it?—Yes.

7489. Longer than a month?—The only fault that I had to find with it was, that, when I drunk it, it slackened my teeth.

7490. Because it was stronger than when mixed with water?—Yes.

7491. About how much tea did each man get to drink?—A pint of tea.

7492. But the ration of lime juice in a pint of tea would not be very strong, would it?—No, that would not be too strong.

7493. Did the men quickly become ill after Hand first became ill?—Yes, on the return home journey they began to fail.

7494. But Hand became ill on going out?—Yes, he was ill going out.

7495. Before you commenced to return I think others took ill?—I remember Jenkins and Craig complaining a day or two before we returned. We were a few days on the way home before Dobing became badly.

7496. Then they all became ill, nearly?—Yes.

7497. Did you become ill?—Not before we came to Newman Bay; not till Dr. Coppinger and Lieutenant Rawson came to our assistance.

7498. You were halting there, were you?—No; we were dragging two men in a sledge at the time they came to us, and the other two were left behind in a tent.

7499. The two that were dragging were not very fit for it, I suppose?—No.

7500. Who was dragging with you?—Lieutenant Beaumont.

7501. He was not well either?—No.

7502. What would have come of you if Lieutenant Rawson had not come to help you?—We would all have died. We were very weak when they came to our assistance.

7503. What did they bring to you?—They had some lime juice; the doctor brought some lime juice.

7504. Did it do them good?—Yes.

7505. You think it did you good?—Yes.

7506. Did you take it?—Yes.

7507. Did you feel any good from it?—Yes, I fancy I did; I was better after it.

7508. How long after you started did you become ill first; how many days after you started?—I was about, I suppose, 78 days out altogether before I began to feel it.

7509. From the "Alert"?—Yes.

7510. What did you feel first?—One of my joints stiff.

7511. Knee joints?—Knee joints.

7512. Did you look at it?—I was often looking at it.

7513. And what did you see?—I saw nothing for a long time.

7514. What do you mean by a long time?—Some days, weeks.

7515. And then what did you see?—A small black spot under the back of the knee, and another up a bit higher.

7516. Then you knew what was the matter with you?—Yes.

7517. Your mouth was not sore at that time?—No, my mouth was not sore at that time.

7518. What did the men who were ill with scurvy, and had sore mouths, get to eat?—The pemmican was the only thing that they got.

7519. Did they like it when they were ill with sore mouths?—Some of them could not eat the pemmican; we soaked bread for one or two of them.

7520. Then did you go to Polaris Bay?—Yes.

7521. Were you carried?—I travelled all the way.

7522. Dragging?—No; Lieutenant Rawson and the doctor dragged the sledge.

7523. And you walked as well as you could?—Yes.

7524. Did you get a rest at Polaris Bay?—Yes.

7525. Did you find any lime juice there?—Yes.

7526. Where was that?—It belonged to the Americans.

7527. And how was it when you found it?—In a cask.

7528. Two casks?—Two casks.

7529. Open or shut?—It was open by the time that we came there.

7530. Did you get any of it?—Yes.

7531. Was it frozen when you saw it?—No.

7532. Quite liquid?—Yes.

7533. Did it look like the lime juice you had been accustomed to?—It was rather darker than the lime juice we had in our vessel.

7534. Was it more tart or less tart?—Fully more, I think.

7535. Certainly not less?—I do not think it was any less.

7536. Did you like it better, or not?—I had no great likings for it, because we mixed it up with molasses.

7537. So it did not matter much, any slight difference in tartness, you mean?—No.

7538. Then you halted at Polaris Bay for how long?—I think about twenty days.

7539. Did you get better soon?—Yes.

7540. Did you get quite well?—Yes.

7541. How soon after getting to Polaris Bay?—In a fortnight, I suppose, I was quite well.

7542. Did your gums ever become bad?—Yes, they were bad.

7543. Did they bleed?—Yes, they bled.

7544. Did spots come out over other parts of the body?—No, only just here, on one leg (*pointing to it*).

7545. Did your spirits go down?—No; I never let down my spirit. I kept it up; I thought it was no use to let it down.

7546. Then you went across to the "Discovery," did you not, in a boat?—Yes.

7547. And did you become ill again?—No.

7548. Before starting, did you prepare yourself in any way; did you take medicine?—No.

7549. You took no physic?—No.

7550. Did many of the men, or any of them, take physic?—That I could not say.

7551. You do not know about that?—No.

7552. (*Dr. Donnet.*) Were the whalers you belonged to temperance ships?—Some of them, and some of them not.

7553. Were you a temperance man?—No.

7554. Do you think the temperance men were better than the men who drank spirits?—I could not say that. I have seen men who were temperance men, and others who were not, and I could not see any difference between them.

7555. What was the allowance of spirits on board ship?—Half-a-gill of grog.

7556. Had you vegetables on board the whalers?—Yes.

7557. Was the allowance the same as that you had on board the "Discovery"?—No.

7558. What difference was there?—We had more on board the "Discovery."

7559. You say you ate the white whale; was it the skin or the flesh?—The skin.

7560. Did you ever get narwhal?—Yes.

7561. Did you eat any of it?—Yes.

7562. Is the flesh of the black whale eaten?—It is eaten by the American people, but not eaten by us.

7563. Do you know whether it is liked by them?—I think it is liked by them, because the Americans eat a good deal of it.

7564. Why do you not eat it?—It is not a customary thing, eating the flesh of the black whale; we eat the skin.

7565. What sort of sleeping berths had you on board the whalers; bunks or hammocks?—Bunks.

7566. Did you find these more comfortable than the hammocks?—I do not know. I was very comfortable in the hammocks. I liked the hammocks very well.

7567. Describe the manner in which you passed the winter months in the whalers?—We amused ourselves sometimes singing, sometimes dancing, and going ashore a short time of an evening to the Esquimaux, to their tents, and having a dance in the night.

7568. How far were the Esquimaux from you?—Perhaps 200 yards; some only 100 yards.

7569. Was there any illness amongst them whilst you were there?—No.

7570. Did you ever see scurvy amongst the officers of the whalers, as you saw it amongst the men?—No, I do not think ever.

7571. What reason can you give for the officers being freer than the men?—My idea is, because they are always moving about more than the men, travelling about, and away with their guns shooting and going about.

7572. You think it is owing to the greater exercise they take?—Yes.

7573. What difference is there between the diet of the officers and the diet of the men?—None at all; nothing to speak about of any consequence.

7574. You spoke of the laziness of the men; did they sleep in their bunks, and remain in them the greater part of the day?—They would sit on their chest lids, and not go on their legs perhaps once during the day.

7575. You say you had hard work during your sledge travelling in the "Discovery" whilst with Lieutenant Beaumont; had you ever harder work in your life?—I do not think that I ever had harder work.

7576. What difference was there between the work you had in the sledge parties, and the hardest work that you ever had on board a whaler?—The difference between the sledging of this expedition and the whaling was, that you were perhaps only two days a week out sledging in a whaler, and of course you were continuing every day with a sledge in this expedition.

7577. Were the weights you carried in the whalers as great as those you carried in the sledges?—Sometimes.

7578. When the men complained of pains and difficulty of walking, did you think them affected with scurvy?—Yes, I did.

7579. Did you see the same in the men in the whalers?—Yes.

7580. You had scurvy in this expedition?—Yes.

7581. Seventy-eight days after you left the "Discovery"?—Yes.

7582. And you believed that you were suffering from scurvy at the time?—Yes.

7583. What do you think is the best thing to cure it?—All that ever I saw was just a change of food.

7584. I think you said that the lime juice did do you a great deal of good?—Yes; I fancy so.

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7585. Do you think the lime juice helped in curing your scurvy?—Yes; I think so.

7586. Do you use molasses on board the whalers? Yes; some of the vessels.

7587. How do they use it?—Some men use it in the coffee.

7588. Was much taken of it?—No, not much of it.

7589. Was it used on board American whalers?—Yes; it is used for mostly everything on board the American whalers.

7590. Do you know how they take it?—With their tea and coffee likewise.

7591. Do you know whether the American whalers have raw potatoes as a part of the diet?—I once saw raw potatoes, but they were preserved with vinegar.

7592. Taken as pickles, or as a salad?—Taken as pickles; it was the only time that I ever saw raw potatoes with them.

7593. Do you think they took it because it cured or prevented scurvy, or did they take it as an article of diet?—I could not say; I only saw it once.

7594. When you went sledging in whalers, had you pemmican?—No.

7595. Had you pork?—Yes.

7596. What was the allowance of each man?—Three-quarters of a pound of pork a day when they were on board ship.

7597. You say you did not like the salt meat?—No.

7598. Which of the meats did you prefer on board the "Discovery"?—The preserved meat I liked very well.

7599. Did you like the corned pork likewise?—I liked the pork very well too.

7600. And which of the vegetables did you prefer?—The hotch-potch.

7601. Is the salt meat served out in the merchant service the same as that you had on board the "Discovery"?—No, it is not quite so salt in the merchant service.

7602. Do you think the men had plenty to eat?—Yes.

7603. Or was there anything they had not, which might have been provided for them?—No, they had everything that was necessary for them.

7604. What was the opinion of your messmates about the outbreak of scurvy in the late expedition?—I could not say; they passed no opinion about it.

7605. Had you any conversation on your return home about it?—No; my messmates had seen very few cases of it; they had never seen cases of scurvy before.

7606. In a conversation you had with Lieutenant Beaumont, you said that many of the men in whale ships had the scurvy "lying between the flesh and the bone all the winter"?—Yes.

7607. What did you mean by that?—I have known people come home from the Straits, and after they came home and got fresh vegetable, meat, and exercise, during the summer season there have come out upon them patches about the size of a two-shilling piece.

7608. After they had fresh vegetable food?—Yes.

7609. What was it?—Scurvy.

7610. Did they soon get well after they had taken fresh vegetable food?—Yes.

7611. Why is lime juice taken on board the whalers?—It is only this last year or two they have been obliged to take it. In former years some ships went away without it, and some took it.

7612. And do you know whether the ships that did not take it suffered more from scurvy?—No.

7613. Did they take anything else, any vegetables?—Yes, they took preserved turnips or carrots, and soup, and bouilli.

7614. In greater quantities than they do now?—Much about the same.

7615. Did you ever belong to a whaling ship that was not provided with lime juice?—No.

7616. All the ships that you have belonged to, have had lime juice?—Yes.

7617. Do you know whether the whalers believe that lime juice is taken to prevent scurvy?—They think it is taken for the sake of the men.

7618. Why did you yourself take it; what reason did you give for taking lime juice?—I took it to keep away the scurvy in the winter season, but I never drank so much of it as I drank this voyage.

7619. Was the snow very deep over which you travelled when attached to Lieutenant Beaumont's sledge?—Sometimes; sometimes it was close up to the hips.

7620. Was it heavier than anything you had in the whalers?—Yes.

The witness withdrew.

MR. THOMAS RAWLINGS, *examined.*

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7621. (*The Chairman.*) When did you join the "Alert," and what was your rating?—I joined her on the day she was commissioned, as Captain of the Fore-castle.

7622. You remained in her until she was paid off?—Yes.

7623. Were you captain of a mess and captain of a sledge?—I was the senior petty officer in the mess, and captain of Captain Markham's sledge.

7624. Enumerate the sledge journeys in which you were engaged?—I was away in the autumn, in the first place for four days, and then again for twenty days. Then in the spring of last year, starting on the 3rd of April and returning on the 15th of June, I think; somewhere about seventy-four days away.

7625. (*Admiral Sir R. Collinson.*) Comparing the "Alert" with others of Her Majesty's ships that you have sailed in, which had the best accommodation for the men?—I should think the "Alert" had more room.

7626. What vessels have you served in previously?—I have served in the "Blanche" in Australia, in the "Severn" in the East Indies and China; in the "Marlborough," in the "Banshee," and in the "President."

7627. As to your provision on board the "Alert," was it better than you were accustomed to have in the navy?—It was all preserved meat which we had in the expedition.

7628. You had salt meat and salt pork so many

days a week?—Yes; the salt beef was not so good, I think, as our proper navy beef, but the pork was very good.

7629. Were the other provisions that you got very good?—Yes.

7630. And were you always able to eat your allowance?—Yes.

7631. Do you think you could have taken more?—No; during the winter time our appetites were not so good as they were when we first arrived up at our winter quarters.

7632. Did you save any provisions at that time?—No; our daily allowance, if we could not eat it, we did not used to draw it.

7633. Then with respect to your berthing at night, had you better hammock accommodation than you had in others of Her Majesty's ships, in your opinion?—About the same.

7634. Did you suffer much from the drip from the upper deck?—No; the upper deck was well housed in.

7635. I am speaking now after you turned in into your hammock, whether you had ever drops of water falling upon your blanket?—No; our bedding was always dry during the winter.

7636. Were any precautions taken to air it?—Yes.

7637. Your bedding was aired?—Yes.

7638. Now, at the end of the winter, when the sun came back, what was your general impression about your shipmates generally; what health were they in?

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—As regards myself, I felt as well as ever I did in my life, before I commenced the spring travelling.

7639. What did you do after the sun came back, by way of taking exercise?—We went away at various times before we started on our spring travelling, for exercise; went away with the sledges with a certain amount of weight in them, taking exercise in that way.

7640. You had some practice then, before you started on the long journeys?—Yes.

7641. What distance did you go out on that occasion?—We used to march out, I should think, some five or six miles, with a load on our sledge, and came back to the ship. Different sledge crews used to go away; about two at a time took their turns day after day.

7642. Was that done frequently?—Yes.

7643. How often were you out with the sledge before you started?—For myself, I was doing, in the first place, quartermaster's duty all the winter, and when the sledge crew were picked out they were exercised. I, myself, was away about four times before we started on sledge travelling.

7644. How far did you get from the ship before you had to double bank the sledge?—About the first day, I think.

7645. You began to double bank the first day?—I can hardly say that; almost the first day. It was very heavy travelling, very deep snow.

7646. Was your sledge as heavily laden as it was in the autumn?—Rather more. I rather think our load in the autumn was about 200 lbs. a man, and in the spring, I believe it was about 240 lbs.

7647. In the autumn, had you much double banking?—Yes.

7648. The same as you had in the spring?—Much the same; but the first three days in the autumn of the twenty days when we started to lay out the depôt, we had very fair travelling, with the exception of one sledge that broke through the ice, and my own sledge broke through the ice. After the third day, it came on to snow very heavily, and continued, and we had very deep snow to go through, and very heavy travelling coming back, especially having to cross over a part of the land on account of the young ice not being strong enough to bear the sledge.

7649. On your return, you had left a considerable amount of your weight at the depôt?—Yes.

7650. So that your sledge had only the provisions that were necessary to carry you back to the ship?—Yes.

7651. And yet you had this heavy travelling?—Yes; and we had to unload our sledge, and carry it piece by piece, over high hills, and lower it on the other side, by our drag-ropes, with a bag.

7652. Where did you begin, in addition to the double banking, to have to unload your sledges as well?—Only in crossing the land.

7653. I am speaking now of the spring journey?—In the spring journey we never unloaded our sledges, not altogether, only in case of capsizing, and when we left the boats behind.

7654. You took something off them?—Yes. In the northern party we were obliged to leave one, the 20 ft. ice-boat, behind, on our outward journey, because we could not drag it.

7655. But you left part of your load behind and went on with the sledge with half the weight, and then came back with the other half, did you not?—In the northern party there were two sledge crews starting with three sledges, the third sledgo to carry provisions which we could not carry on our own two sledges; and therefore in the heavy travelling we had to tell off a party of four men to go road-making, the remainder to advance each sledge one at a time.

7656. So that you had, as it were, with one crew, to advance the three sledges?—With the remainder of two crews, after the road-makers were gone.

7657. When did the third sledge leave you?—The

third sledge never left us, not the northern party. There were two sledge crews dragging three sledges.

7658. About what time were you attacked so that you could not do your work?—I was attacked on the outward journey: I cannot tell the date, but I kept on my legs until the relief party came up to us.

7659. Then you, although not able to drag, were not obliged to ride upon the sledge?—No, not till the relief party came out, and then the doctor put me on the dog-sledge.

7660. (*Admiral Inglefield.*) Have you formed any opinion as to what the best age for men is on that arctic service?—No.

7661. Do you think your crew were the right age, or too young?—I think they were very strong, and very healthy men. I could not have wished for a better crew than what we had.

7662. When you were travelling, which did you think afforded the greatest comfort to the men and enabled them to do most work, tea or rum?—Well, after our mid-day meal, lunch, we all felt better able to do a day's work than we did in the morning.

7663. And what had you for that lunch?—We had tea, and four ounces of bacon, and some biscuit.

7664. When did you take your rum?—We took our rum in the evening after our dinner; that used to send us off to sleep.

7665. If you were going away with a party of men to-morrow, would you have the same arrangement of food as being the most convenient to travel upon?—Yes; and I would have tea in the middle of the day.

7666. What about lime juice; do you think that if you had taken lime juice on your journey it would have been the means of keeping off the scurvy?—With my party we took six days' lime juice.

7667. And did you drink it every day?—We took it, and when the scurvy first broke out Captain Markham issued it to the worst cases.

7668. Then it was taken only as a medical comfort?—Yes.

7669. Not as a ration. Do you remember anything about the salt beef you had issued to you?—Yes.

7670. What sort of stuff was it?—I think it was not so good as it ought to have been.

7671. Was it as good as that you generally get in men-of-war?—Well, I have had much better in men-of-war.

7672. Was there any other provision that you could complain of?—No.

7673. Every thing else was good?—Every thing else was very good.

7674. Had you as much to eat as you possibly could?—Yes.

7675. When you were taken upon the dog-sledge to be brought back, what was your condition?—Scurvy very bad in the leg.

7676. Black blotches?—All discoloured, from my toes right up to my hips.

7677. Were your gums swollen?—No; the gums did not get sore or swollen till after I got on board the ship.

7678. Did the teeth come loose?—No; not till after I came on board.

7679. Or bleed?—No. I had contraction of the leaders underneath the knees.

7680. I daresay you heard some talk on the lower deck at various times; did you ever hear any talk among the men as to what brought on the scurvy?—No; we could not tell what brought it on. Most of us read a great number of books during the winter, more especially arctic books, and we did not eat more salt meat than we could possibly help; plenty of fresh meat, and we tried to leave off the salt.

7681. Did you have any fear at starting that you were going to have the scurvy?—No; that was the last thing we thought of.

7682. (*Dr. Fraser.*) The salt beef was not very good, you think?—No.

7683. Was it always eaten when it was served out?—On account of its being not so good we seldom ever took it up, because we made our fresh meat do instead.

Mr. T. Rawlings. 7684. You did not get fresh meat the same day, did you?—No.

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7686. What had been left from some previous day?—Yes; we used to make it do on that day.

7687. And you did not take up your salt meat?—No; not after we found it was not so good as we expected.

7688. Was it issued all through the winter?—It was issued if you liked to take it up on the proper day.

7689. Was it general that it was not taken up by the men?—It was not taken up at all; it was very dry and very hard; there was no nutriment in it, I should think.

7690. Did you like all the other provisions on board the ship?—Yes.

7691. Everything else was good?—Yes.

7692. The vegetables were good, were they?—Yes.

7693. You had vegetables, I think, every day, had you not?—Yes, preserved potatoes and cabbage, either one or the other, at different periods.

7694. Did you like the cabbage; it was compressed cabbage, I suppose?—Yes.

7695. Did you like the compressed vegetables generally?—Yes; we were all glad to get anything of that sort; we always preferred it, because we thought it would be better for us.

7696. What kind of vegetable did you get most of in the week?—I think potato most.

7697. How often in a week?—Three times a week.

7698. Did you have any other vegetable on those days?—After the scurvy broke out we had it every day.

7699. I mean in the winter, before the spring sledging. You had potatoes three days in the week, I think you say?—Yes.

7700. Did you have any other vegetables on the same day that you had potatoes?—We had onions in their turn, and carrots; sometimes they would drop on the same day with potatoes.

7701. Was it a large mess of potatoes, or do you remember how much?—I cannot tell the exact allowance; it was quite sufficient for us.

7702. As much as you could eat?—Yes.

7703. Was it more or less than you used to take on the sledge?—More, I think, than we took sledging.

7704. What was the diet that you had in the autumn sledge party; just the same as that you had in the spring?—In the autumn we took two journeys, for four days and twenty days; for the four days we had preserved meats, and for the twenty we used pemmican as in the spring.

7705. What did you eat instead of pemmican?—Preserved meat.

7706. And with that exception was it the same?—With that exception it was the same.

7707. The same quantity of potatoes?—Yes.

7708. No other vegetables?—No.

7709. The men were all well, I think, during this autumn sledging?—Yes.

7710. None became ill afterwards?—No; only those from "frost-bites."

7711. You never found, I think you have already said, the main deck at all stuffy, did you?—No.

7712. You think it was nicely ventilated?—Yes.

7713. Were your own quarters well ventilated?—Yes.

7714. You had a great deal of exercise with sledges before you started in the spring?—Yes.

7715. Did the whole crew engage in that exercise?—All the sledge crews that were going travelling.

7716. The greater part of the whole crew?—Yes.

7717. What exercise had you before that, during the winter?—We were obliged to take two hours' exercise, at the least, every day.

7718. Was that out of the ship?—Yes.

7719. And if the weather were bad, I suppose you did not get all that?—We generally used to get out,

some way or other, during the day, on the leeside of the ship, if the weather was bad.

7720. Was that all you had, two hours a day?—It was compulsory to have two hours; of course many days they had much more.

7721. Had you any exercise on board the ship?—Yes.

7722. What sort of exercise?—Walking up and down the upper deck.

7723. Was that part of the two hours?—No.

7724. And how many hours do you think you had altogether, counting the exercise on deck as well as that outside?—Speaking of myself, I was, of course, quartermaster during the winter, and had my watch to keep, night or day, four hours.

7725. How many watches were you in?—Six watches.

7726. Besides that you had your exercise, two hours?—Yes.

7727. But that is a larger share than most of the crew, I suppose?—Most all the crew was on deck, or outside the ship during the day.

7728. Then did the two hours, which you say were compulsory, include the work done outside?—It did include the work.

7729. What do you think was the condition of the northern party when you started?—I think we were all in very good health, very strong, and very eager to push ahead.

7730. No one the worse for the winter they spent on board?—No one appeared the worse.

7731. And, judging by the way they worked, do you think that they were the worse at all?—No.

7732. They worked as well as they could?—Yes.

7733. Even as well as men in the best of health could have worked?—Yes; and even when the support sledge left us, we were all well.

7734. Your appetites were good?—Yes.

7735. You ate your full allowance?—Yes.

7736. Was the pemmican liked?—Yes.

7737. Could you have eaten more potato?—No; our allowance that we took was about as much as we could eat.

7738. Potato, I mean especially; could you have eaten more at that time?—No, I do not think we could have eaten more.

7739. The quantity of potato that you had while sledging was less than you had on board ship, you have told me: now, could you have eaten more while you were sledging?—No.

7740. Why?—Because we had sufficient.

7741. You managed to eat more on board ship than you could eat while sledging?—On board the ship, if we could not eat it, we could leave it, or leave it behind.

7742. Did you miss the lime juice?—No.

7743. You do not care for it, do you?—I rather like it.

7744. You yourself always took it on board ship, did you?—Yes.

7745. I suppose the men all did?—Yes, every man took it; their names were called out, and there was the officer of the watch, or some one there, to see that they did take it.

7746. Did they all take the double allowance that was started about March, I think?—I think the greater part of them took it.

7747. That was not so carefully superintended, I think, was it?—Not the extra allowance.

7748. (*The Chairman.*) It was sent down to the messes, instead of being served out?—Instead of being served out in the regular way, it was sent down to the messes.

7749. You think it was generally used?—Yes; we used to take it instead of drinking water; we used to rather like to have it in the evening.

7750. (*Dr. Fraser.*) Do you remember if there were any men in the "Alert" who did not like the lime juice?—No; I do not know of any one.

7751. The bacon, when you were sledging, I think, was taken at lunch?—Yes.

7752. You had four ounces, I think, generally?—Yes.

7753. It was afterwards, or some time after, I believe, increased to six ounces?—During the autumn it was six ounces, not during the spring.

7754. The previous autumn, you mean?—Yes.

7755. That was when you had no pemmican?—Yes.

7756. But in spring you always had four ounces?—Four ounces.

7757. Which of the pemmicans do you like best, the sweet or the common?—I rather like the sweet best.

7758. And that seems pretty general; most of the men like the sweet?—Yes.

7759. Did you like the rum that was taken?—I liked it in the way that we used to have it in the evening.

7760. You think it was a very good thing to make you sleep?—That is what we took it for; and, I think, it was very good for that.

7761. After being a little over-fatigued you might not have slept, perhaps, if you had not had the rum?—No.

7762. You were sometimes over-fatigued?—Yes, we were pretty well done up. After our supper, I think the half-a-gill of rum was very good to send us off to sleep; assist in making us go to sleep.

7763. You would not like to go without that, I dare say?—We all enjoyed it.

7764. Who was the first man who became ill in your party?—Shirley.

7765. And about what time after the 3rd of April, when you started, was that?—I think it was twelve days after, when he was first taken.

7766. Was he sent back?—We could not send him back: our support sledge had left us on the tenth day.

7767. Do you think the work was harder in the spring travelling than the autumn? Your load was greater: was the ground much more difficult?—The ground was much the same, but we had a great deal more road-making to do in the spring, on account of leaving the land. I should rather think the spring travelling was heavier.

7768. That was additional work, the road-making?—Yes, and in very deep snow.

7769. Did you carry a boat?—Yes, we carried a 20-ft. ice-boat, and a 15-ft. ice-boat.

7770. Two boats, three sledges, and two crews?—Yes.

7771. What do you think was the weight that each man had to drag, taking into account that there were three sledges, two boats, and only two crews?—Each man never had to drag more than 240 lbs. a man at one time, although he was dragging that at each sledge.

7772. This man, Shirley, was the first who became decidedly ill in the northern party?—Yes, he was attacked in the knees.

7773. What did he complain of first?—About pains in the knees.

7774. Was he weak before that?—No.

7775. He worked up to the time that the pains became bad in the knees?—Yes.

7776. Now, in all the cases that you saw, did you generally find that pain was the first thing that they suffered from, or had they some weakness?—This man, Shirley, complained of pains in the knees, but I felt it underneath the knees a stiffness, getting worse every day, in the leaders. I never had any pains at all, in the legs or knees either.

7777. Before that the appetite had not fallen off at all?—No.

7778. It was after?—Yes.

7779. After these pains a great weakness came on, did it?—I cannot say that I ever felt very weak; the leg was the only thing that troubled me.

7780. Others did feel it?—Those who were carried were very weak.

7781. And others who were not carried were very weak; they could scarcely walk?—Yes, they got short-winded.

7782. Did you go as far as the party went?—Yes.

7783. Did you return with them?—Yes.

7784. Why did they return?—We were out the proper number of days to be out on the journey.

7785. And how many were disabled before you commenced to return?—Five; we were carrying them on our sledges.

7786. Then your loads would be rather greater than when you started?—Taking into consideration the boats we were obliged to leave behind, and the amount of provisions consumed, our weights were almost about equal.

7787. Did a party come to your relief?—Yes.

7788. What party?—Captain Nares came after us.

7789. What was the state of the sledging party then; nearly all ill?—Every man had the scurvy, more or less.

7790. Then it was fortunate that Sir George Nares came to your assistance?—Yes. Captain Parr went to the ship and got assistance.

7791. Was the party carried back to the ship after Sir George Nares joined you, or did you rest anywhere?—After the relief party came up we rested while we pitched our tent and were examined by the doctor, Dr. Moss, and a few medical comforts were issued out, and we pushed on for the ship in short stages.

7792. Were you on the sick list on board ship?—Yes.

7793. And where were the men all kept; where was the hospital?—On the after part of the lower deck.

7794. Can you remember how many men were there at one time when you were there?—I could not say the number.

7795. A good many?—A good many.

7796. Somewhat disagreeable, I daresay; sores and wounds, were there not?—No, no wounds at all.

7797. You do not remember how many cases there were at one time?—I could not say the number of cases at one time, but there were a great number.

7798. As many as the place could hold?—Yes. The worst cases were put in the cots, and the remainder of us had our bedding on the deck.

7799. What doctor chiefly attended to these cases; under whose charge were they?—Dr. Colan.

7800. What assistance had he in the way of nursing?—He had the ship's steward, and the ship's cook.

7801. Two persons?—Yes.

7802. Did you see that he had a great deal of work to do at that time?—Yes; Dr. Colan was up many hours, night and day.

7803. He had to do a great deal of the nursing, I presume, had he not?—Yes.

7804. A very disagreeable kind of nursing?—Yes.

7805. An extremely dirty sort of nursing?—Yes. Dr. Colan was up day after day, and all hours of the night, tending all of us.

7806. Extremely attentive?—Yes.

7807. That was over some weeks, was it not?—Yes.

7808. Did Dr. Colan himself become ill from the great amount of work which he had to do?—Yes, I believe he was very ill for a time.

7809. At the end of that time?—Yes.

7810. (*Dr. Donnet.*) What amount of exercise did the men of the "Alert" take during the winter months?—The compulsory exercise was two hours.

7811. Did they take any exercise besides this compulsory exercise?—They went about their daily work, fetching ice and banking the ship up, and taking away the different dirt from the ship: employed generally outside of the ship the whole of the day, unless the weather was too bad.

7812. They therefore took more than the two hours which by rule they were obliged to take?—Yes; that two hours was the compulsory time.

7813. During the coldest months did you take the same exercise?—Yes.

7814. Do you remember whether you took more or less exercise during the month of March?—No; it

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was very cold in March, but we took our usual exercise.

7815. Do you think that all the men on the ship took sufficient exercise?—Yes.

7816. Had you any training for sledging before you started for the spring parties?—Yes.

7817. Will you describe what sort of work it was?—Not so heavy as it was in actual sledging.

7818. Do you think this training did good to the men, and fitted them for the sledge travelling?—Yes.

7819. Was the work you did during the real sledge travelling, as captain of the sledge, very great?—Yes.

7820. Do you think it was the hardest work you ever did since you have been in the service?—Yes.

7821. In what way was it harder?—The work was incessant; it was very heavy; the snow was that deep that you sank right down through it, and you had to pull your leg out of the same hole again, and to take the next step in a similar way; and the sledge would bury itself into it; and the snow drifted here and there, heaving it up into hillocks; you had to drag your sledge right up over it, or cut through it by means of pick-axe and shovel.

7822. Were you not able to go round these hummocks?—In many cases we were not; where we could go round them, we went round them.

7823. And what was the height of the hummocks that you cut through?—I can hardly tell the height.

7824. What was the highest hummock that you ever went over?—There are a number of hummocks, where the ice clashes together and heaves it up into all sorts of shapes; those you had to cut into and level so that you could get your sledge over it. The highest would be perhaps from 10 to 15 feet.

7825. Were not these hummocks as hard as ice?—Yes: they were ice.

7826. And how did you manage to get a road over these hard hummocks?—The pick-axe would do a lot of work among ice.

7827. What was the longest time employed in cutting a road over these hummocks?—From two to three hours. We would camp, perhaps, at the edge of a lot of hummocks to-night and get up early in the morning and send a party on to make a rough road, while the remainder packed their sledges and got ready for travelling, and advanced one sledge on at a time. After we had gone through that hummock we would have to go on till we came to another and cut through that again.

7828. Did you take the boats over these hummocks?—Yes.

7829. How did you manage to let them down on the other side?—We used to ease them down by means of lines that we had at the rear of the sledges.

7830. In doing this were you ever obliged to unload your sledges?—No.

7831. Did you ever carry any of the men that were sick over hummocks such as you have described?—Yes.

7832. Did they not suffer much by this dragging?

—They suffered a great deal because we had to lash them on the sledges.

7833. What was the depth of snow in the parts you said you found it so difficult to travel over?—In many places it was three or four feet in depth. In places where it was much deeper we had to cut through with our shovels; the very deep snow was drift.

7834. Describe the manner in which you walked through it?—The leading man on the drag-rope used to step out and sink into the snow, and we used to try and manage to go into the same footsteps.

7835. Had you many fine sunshiny days during your sledge travelling?—Yes, but very thick and foggy during our backward journey.

7836. Were you ever obliged to encamp from the badness of the weather?—Yes.

7837. For how long?—The camping, I think, was three days, at different periods.

7838. Never three days at one time?—No, only one day at one time; then it was blowing very hard.

7839. What did you do during this time?—We used to read. Captain Markham used to read to us out of one of Dickens's works.

7840. Will you tell the Committee the time of day you halted?—The travelling in the best part of our journeys were done at night time.

7841. You travelled therefore by night, and not by day?—Yes.

7842. Was that owing to the sun being in your faces?—So that the sun would not be powerful for our eyesight.

7843. What sort of spectacles or goggles did you wear?—Very light green glass, a shade of green.

7844. Have you ever suffered from snow-blindness?—No.

7845. What time did you take to encamp, to pitch your tent?—About twenty minutes.

7846. What time elapsed before you were able to get your luncheon ready or your meals ready?—About an hour and a half, or from that to two hours.

7847. Was a man told off to do the duty of cook?—Yes, every one took their turn, except the captain of the sledge and the officer of the sledge.

7848. Can you describe the duty of the cook?—The cook had to shift his foot-gear the first thing, the gear that he had been travelling in during the day; put on dry things, and get his cooking apparatus ready; trim the lamp, light it up, and commence to melt the snow all ready for the tea; after the tea was made he would have to cook the pemmican; then replenish his lamp, and get everything ready for the morning.

7849. What time did that take?—The cook, before he could get into his sleeping bag, would take about three hours, I suppose.

7850. Were any of the men ever frost-bitten whilst doing cook's duty?—No.

7851. Did you all like your tea?—Yes.

7852. Was the tea hot when it was drunk?—Yes.

7853. What do you take lime juice for in the service generally, do you know?—As a preventive of scurvy, I believe.

The witness withdrew.

COLOR-SERGEANT WILLIAM WOOD, examined.

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7854. (*The Chairman.*) When did you join the Marines?—In the year 1861.

7855. How many years have you been a non-commissioned officer?—Fourteen years, next July.

7856. Did you join the "Alert" on the day on which she was commissioned?—The day after.

7857. And did you remain in her till she was paid off?—Yes.

7858. (*Admiral Sir R. Collinson.*) Comparing the accommodation for your party on board the "Alert," was it superior or inferior, on the lower deck, to that to which you had been accustomed on board other of Her Majesty's ships?—It was inferior; not anything

at all to compare with the ordinary accommodation of a man-of-war.

7859. That is to say, had you less space for messing and for sleeping in?—No; I should say it was about the same, as far as room goes; about the same as any other ship.

7860. How was it inferior, then?—The mere fact of the atmosphere in the country made it inferior.

7861. It was not the space of the lower deck, but it was the condition of the lower deck, that you complain of now?—Yes, and caused through the atmosphere.

7862. My first question was put to you rather with

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respect to the real space which you had to live in; was it as large as what you generally get on board of Her Majesty's ships?—Yes, about the same.

7863. You think that its condition was not so good?—No; I do not think it was.

7864. Will you explain to the Committee what you think was wrong in it?—I will endeavour to do so. Speaking of another ship, there was scarcely one on a station, or anywhere else, but would have had her full complement of men, which perhaps the "Alert" or the "Discovery" had not, owing to the service which she was engaged on; but in another vessel, the same size and class, as herself having the full complement, I think they would have been rather, if anything, more pushed for room than we should have been, taking into consideration that we had the same sort of mess traps and mess lockers; having as near as possible about the same sort of things, I should imagine that we had as near as possible the same amount of room as any other ship would have, on account of having less men to occupy that space. Then again, as to the accommodation not being so good as in another ship, the hatchway would invariably be opened to take off the atmosphere, whereas in that country you cannot take the hatchways off, consequently you must put up with it as best you can by getting the foul air off the deck as well as you can during the winter.

7865. What means were taken to get the foul air off the deck of the "Alert"?—There were uptakes for that purpose stationed in different parts of the ship, consisting of stove funnelling.

7866. Do you think that they were useful?—Very useful, indeed.

7867. What means were taken to let fresh air down to the deck?—The same sort of thing, only stationed in a different position. In summer time hatchways were opened.

7868. Were you yourself a witness of the working of these uptakes and downtakes?—Yes.

7869. And do you think that they were in a certain measure successful?—Very successful indeed.

7870. Had you much moisture on the lower part of the upper deck overhead during the winter?—On the upper part of the lower deck, on the beams underneath the upper deck we had moisture there.

7871. Did it drip much?—Yes, it would very often drip.

7872. What steps were taken to cure that?—There was a man employed very often wiping it down three or four times a day to keep the beams dry.

7873. How many stoves had you on the lower deck?—One stove on the mess deck besides the galley; the galley fire was burning all day, but the stove was going night and day.

7874. Where was that stove placed?—Before the fore hatchway.

7875. Was that stove kept burning at night?—Yes.

7876. Was there, according to the best of your recollection, more moisture during the night after you had gone to bed than during the day?—No; there was not so much at night, but it differed very much.

7877. When the lower deck was cleared during the forenoon, was it kept strictly clear and nobody allowed down upon it?—Yes, unless there was any work of great importance going on.

7878. So that all the ship's company were kept away from there?—All but the cooks; the two cooks would occasionally go down to attend to their work, and if they missed their time of exercise they would have to go up afterwards; they often had to attend and do their exercise in the evening.

7879. Then perhaps this exercise that was taken by the cooks came especially under your jurisdiction?—It was; I had to look after them to see that they went out.

7880. It was your business to see that the idlers, as they are called on board a man-of-war, took the exercise which was prescribed by the captain?—Yes.

7881. You had also, perhaps, some jurisdiction with

respect to the men not coming down on the lower deck, unless they were passed down by an officer?—That was their orders; but they would not get passed down. If they were sent for anything, they would invariably acquaint me with what they were going for, because, if there was any man left in the ship, I would go up on the upper deck myself, invariably, by one of the ladders, when all was clear, and then go on the floe myself.

7882. Consequently you, as it were, were both morning and afternoon in charge, so that the lower deck was not occupied by the men without authority?—Not in the afternoon, but all in the forenoon were clear of lower deck.

7883. What was done in the afternoon with respect to the men remaining below?—From 1 to 2.30 was the dinner hour; the men came in from the floe at $\frac{1}{4}$ to 1, and then they piped dinner at 1; and at 2.30 they either commenced work again, or whatever was going on; or making and mending clothes during the winter months; whatever might be going on they would attend to, whether it was on the floe, or on deck, or down below.

7884. Was the lower deck cleared in the afternoon?—No; unless anything was going on especially, but always in the forenoon.

7885. Now let us pass to the provisions. What is your opinion of the quality of the provisions which were given to you on board the "Alert"?—Very good.

7886. Was it all good?—Yes; it was all palatable; what I should call good food.

7887. Was any of it better or worse than what is usually supplied to Her Majesty's ships?—No; according to my opinion.

7888. We have had the salt beef complained of?—Except the salt beef; I was going to make that one exception; that is about the only one I could find fault with about the provisions. The salt beef was very indifferent indeed, so far as the salt went; in fact, it was so salt that we could not eat it.

7889. With respect to yourself, were you able to consume all your allowance during the winter?—It is hard to say for a certainty, because sometimes I have gone for one or two days and ate but very little preserved meat, and then, when I have felt hungry, I have eaten an immense lot. I would be doubtful about what I did eat myself. I think I ate my share right throughout the commission. I think I ate the whole of my rations.

7890. But there were particular kinds of provisions that you did not like?—Yes, there were.

7891. Will you specify to the Committee what those articles were?—Minced collops, salt beef, and ox cheek.

7892. On the days when those were issued you did not make as good a dinner as you would have liked to have done?—I used to make about the same dinner, by using part of what we had left perhaps from the day before.

7893. Do you think that the dislike to these particular provisions was shared by other people besides yourself: were there other men on board the ship who did not like these things?—Yes, especially those things I mentioned, the salt beef, and the minced collops. If I speak for the majority of the men, I think there was no one liked them.

7894. Did it ever occur to you to ask the captain to change the ration, so that you might get something which you liked?—It often occurred to us, but we never carried it into effect as a body of men, simply because we knew that we were in a country where it could not be rectified by appealing: it did occur to us many a time.

7895. With regard to the lime juice, did you take the lime juice regularly?—Regularly.

7896. Did you like it?—Very much.

7897. Did all your party like it?—With about one exception, or it might be more; but whether they liked it or not, they had to take it.

7898. But still it was not generally liked by the

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whole of your party?—Yes, it was generally liked. There were one or two only who did not like it, but they had to take it for all that.

7899. What was the condition of the health of those one or two after the winter was over; were they any different from their comrades?—No, they were about the same as the rest of those who went on the long sledge journeys. In fact, I cannot say that they were any worse. Those two men were about the same as the others.

7900. Passing from the diet on board the ship, we come to the diet on the sledge. How did you like that diet?—I liked it very well as long as I could eat it.

7901. Do you think you would have liked less pemmican and more potato, or do you think that the allowance of potato was just what would suit you, provided you had to go another journey?—The potato was very good, but we would have liked a little more, and I should certainly have liked a little more bread on occasions, and less pemmican.

7902. Is there any other change in the diet which you would suggest should take place in the sledge ration?—Only the bread.

7903. You did not carry lime juice on the sledge journey?—No, only part of the way.

7904. Was any given to you while you were away on the sledge?—Yes, when we were coming back to the ship?

7905. Do you know how it was carried?—Yes.

7906. Will you describe to the Committee in what condition it was when served out to you?—It would be in the early part of June when we came to one of our depôts, coming back towards the "Alert." The dépôt had been placed there by one of the other sledge crews, so that we might pick it up coming back, when we found a small pot; you might call it a jar, it was an earthenware jar holding about a gallon, and stowed in the dépôt.

7907. Was this frozen or liquid at that time?—It was just the time that I and a few others fell bad. We did not walk to the place to fetch it; we fell down by our sledges, while the other men who could walk went and fetched it. I did not see it until it was served out, and it was served out in a liquid. I could not say what it was when they found it there.

7908. Therefore you took no lime juice away from the ship whatsoever?—No; we had been without lime juice until that day.

7909. Were you glad to get it?—Yes; we were glad to get it for the sake of the drink.

7910. You have no other suggestion to make with respect to the provisions that should be carried by the sledge than what you have already given to us?—No, only there should be an increase in the bread.

7911. (*Admiral Inglefield.*) What number of hours did you travel on your sledge journeys?—Nine hours.

7912. And when was your tea taken in the course of the journey?—After four and a half hours of sledging.

7913. During the middle of the day?—Sometimes we used to travel by night; and either by night or by day, whenever we had travelled four and a half hours, we used to have it.

7914. Was it much relished by the men?—Yes very much indeed.

7915. Do you think that they preferred it to rum?—Yes, I think they all did.

7916. Rum was relished at certain times; when was the best time for taking rum?—When it was issued, when the men had had their evening meal, and were in their bags and going to sleep.

7917. It gave them a sort of glow which enabled them to sleep, and caused the blood to circulate?—Yes, I think that was it.

7918. In any future journey you would prefer having the tea in the daytime, and the rum upon bagging?—Yes, just the same as upon this occasion, with the exception of more bread.

7919. I should like to know what sentry-go you

had on board ship?—None at all, only the decks were patrolled by the quartermasters and myself.

7920. But there was no sentry-go amongst the men?—No.

7921. None at the captain's cabin door, or over the spirit room?—No, the spirit room was kept locked.

7922. Then the marines in every way did duty the same as the blue jackets during the winter months?—Yes, and they were ward room servants, in addition to their ordinary duty.

7923. The lime juice, you say, was drunk, without exception on the lower deck by everybody?—Yes.

7924. Did you ever hear any talk on the lower deck amongst your party as to what they thought about the provisions, whether they would have liked something different, and whether they thought there was anything in the provisions that produced scurvy, as they must, more or less, have discussed the subject amongst themselves?—Yes, it was discussed by a great many of them in the manner which I described just now, about what they liked and what they did not like, that is, the minced collops particularly, and the ox cheek diet, and the salt beef.

7925. Did you form any opinion as to what was the best age for arctic service. Amongst your party, I suppose you had none much over 30, had you?—Yes; there were, perhaps, a few of the men that were over 30.

7926. What age are you?—Thirty-four next birthday.

7927. But the majority of your men were under 30?—Yes.

7928. Do you think they were of a good age for doing the work?—Yes, very good, indeed.

7929. The beef, which you said was bad upon the whole, was not taken up by the men, I believe?—No.

7930. Had you scurvy?—Yes.

7931. Badly?—Yes.

7932. Were you obliged to be dragged upon the sledge?—I believe it was two or three days.

7933. What were the symptoms with you?—The under part of my legs drawn up, both ankles swollen up, and my left leg very much swollen, black, blue, green, red and, all sorts of colours, a combination of colours.

7934. Did your gums swell?—Very much over the teeth. You could scarcely see the teeth.

7935. Did the blood come from them?—Occasionally; always when eating.

7936. Do you feel any bad effects of the scurvy now?—A little swollen in the left ankle at the present time, and when sitting in one position it catches me in the knees occasionally.

7937. And yet you were delivered by the doctor as being cured?—So I was, in a measure.

7938. What do you think has brought it on; is it the weather?—No; I think it is a thing that will hang to me for another month or two. I feel myself gradually getting better. I think it will die away in the course of a few months' time.

7939. Still you have the feeling that you have had scurvy?—Yes; I prove it by walking a mile or two a sharp walk. I have proved it in that case.

7940. Would you like to go upon another arctic voyage?—Unless I was detailed.

7941. You would not volunteer?—Not unless I saw something in the way, I would not.

7942. How about your party, are any of them with you now?—Two of the men are; they are on leave now, and therefore not at work.

7943. Do you think that they would care about going again?—Under some circumstances, I believe they would go now, the same as previously.

7944. They would go, if they were ordered, but they would not volunteer?—I do not think they would; I have never asked them the question, but I do not think they would.

7945. (*Dr. Fraser.*) What fault did you find with the minced collops and ox-cheek?—Both preserves were very good, but no one seemed to like them; they did not take them up like they would their

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stamina or their staff. There is something in them that we could not seem to like; we could not eat them; in a coarse manner of speaking, we used to call them blood and sawdust, at last.

7946. Do you know what minced collops are; have you eaten them at other times?—I do not think I ever did, in my life.

7947. Then you do not know whether they were better than minced collops generally are?—I do not.

7948. Was there vegetable mixed with the minced collops in the pot?—No; unless it was intermixed with it in its manufacture, but it was not visible.

7949. What was the matter with the ox cheek?—It was too rich; I cannot pretend to say exactly, but it was the same with the ox cheek and the minced collops; at the first start I was very fond of it, but after I had had about three meals of it my stomach would not take it; I would rather go and eat a bit of preserved meat, of any sort, than eat a bit of that.

7950. And you did not like the salt beef either?—I am very fond of salt beef, but not of that; it was too salty. I tried all sorts of ways of dealing with it; I soaked that beef and cut it, and soaked it again, and I tried all sorts of methods to make it suitable, but I could not do it.

7951. You had vegetables every day, had you not, at dinner?—Yes.

7952. And at breakfast?—No; only once a day.

7953. Had you vegetables at supper?—No, unless you saved any from your allowance at dinner time, and there generally was some left, so that some men would perhaps have it twice a day.

7954. What vegetable had you most frequently in the week?—Potatoes.

7955. How often in the week?—I will not be positive about it, but I think we had potatoes every other day; there were several sorts of vegetables, and we had vegetables every dinner meal, either mixed vegetables or potato.

7956. You had a large quantity of potato when you got it, had you not?—Plenty of it; as much as any man could eat.

7957. I think you said that the atmosphere was not very good sometimes between decks?—It was not what I should call good; nothing like it is to day, for instance, and not so nice and fresh and sweet as it is here.

7958. Did it smell stuffy?—No, I could not tell what it smelt of: it was a kind of close smell, though all the uptakes and the downtakes might be in full swing; it was a close and damp smell, I should call it.

7959. What time of the day did you notice it, or was it throughout the day?—Right throughout the day, I might say. It was only during the winter, that I am speaking of.

7960. It was close because you could not have enough openings to let the fresh air in in sufficient quantity, was it not?—I do not think it was that exactly, because, if we had had the hatchways open, we should have been damper still. I think it was more the country, and I should think it was almost impossible to avoid it, because, if you had too many fires on each of the decks, it would become damper still.

7961. I believe that you yourself sometimes had to look after the men taking their lime juice, had you not?—Yes.

7962. Then, no doubt, you did your duty, and saw that everyone took it?—Yes, I did. I ticked the names off my book as they came up.

7963. Did the steward take it at the same time?—Yes, the steward always did.

7964. In fact, every man took his lime juice?—Every man. There was one man excused drinking the half a pint at once, but he had to take the other half in the evening.

7965. Who was that?—Francombe.

7966. Was that because he was ill?—No; it was because he could not take it. I believe he had not been used to it, and he could not drink half a pint at once: he preferred taking the other part in the evening.

7967. What were the exceptions that you found to the willingness of the men to take it?—Simply because, when it was piped for, if a man was not there, he knew that someone would check him presently to come and fetch it. There was a case occasionally, now and then, when a man would be down the stoke-hole doing something that he could not leave at the present moment; and when a case has occurred like that, I have taken it down myself, and given it to him.

7968. Then some of the men did not like it?—I think most of the men liked it.

7969. You said, I think, that there were one or two who did not?—Only two.

7970. Who were those?—Pearson was the other man. They did not care much about it; and I do not suppose they would take it if they were not obliged.

7971. You liked the sledge diet, did you not?—Yes; very well, for sledging purposes.

7972. You liked it so long as you could eat it?—Yes.

7973. That was until you became ill, I suppose?—Yes.

7974. I think you have said already that the potato you thought was scarcely enough?—Scarcely enough.

7975. Was it decidedly less than you got on board?—I would not say that; it might be a trifle less. I do not know the exact weight of it.

7976. You think, also, that you had not enough bread?—No; we had not enough bread.

7977. You had nearly a pound, had you not?—We should have liked to have had a deal more than what was allowed.

7978. You could have eaten a great deal more, could you?—Yes.

7979. Could the men generally have eaten a great deal more?—Yes; every one in my sledge could.

7980. Do you mean that you could have eaten more in addition to what you were already getting, or would you rather have had it as a substitute for something else?—I would rather have four ounces more bread and take two ounces less of pemmican, or six ounces more of bread and four ounces less of pemmican.

7981. Do you think that that would have been more agreeable?—Yes.

7982. Did you miss your lime juice when you started sledging?—Not when we started; but we did when we were away.

7983. When did you miss it?—Before we had been half the journey, I suppose.

7984. Why did you miss it?—Through the thirst, chiefly. A man thirsting like that, with dry lips and parched throat, is not allowed to eat snow; he knows it will do him injury if he does, so that the only thing he will do will be to wait until he could get a drink either of tea, or a drop of water, if he can get any out of the condenser while the cook is at work, if he has got half-a-gill to spare.

7985. You think you would have used the lime juice if you had carried it?—We should have had to have used it, by the same rule as the tea at lunch, or at the mid-day meal.

7986. How would you have carried it if you had had it?—We should have had to carry it in the ordinary method. The lime juice would have been separate by itself, if it had been liquid; it would have had to have been in a jar, for instance, like a spirit can, holding about one gallon. It would have been in a tin, like that on the table, and the chance would be that it would not freeze very much, and we should serve it out. We should require a measure, and we should require sugar and stearine to make the water with to mix it with.

7987. Could you have melted it if you had carried it?—If we had had more stearine and more wick, we might; it would require more of both to be able to do it, and we could not do that in our case, because we had no more stearine than we could cook our provisions with.

7988. Would there be any inconvenience in using it somewhat in this form (*handing a lozenge to the*

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witness); does that taste like the lime juice?—Yes, it is stronger, but the taste is as good.

7989. Who was the first man in your party who became ill?—Myself.

7990. How many days after you had left the "Alert" did you become ill?—When I say I was ill, I was not exactly ill, but mine was the first case of scurvy that broke out that was noticed; but I continued at my work until within the last 14 or 15 days of joining the ship.

7991. When was it that the scurvy first commenced with you?—Towards the latter end of April, about the 28th or 29th.

7992. And you were the first to be attacked?—Yes.

7993. Were the marks then first noticed upon the skin?—That's all.

7994. Were you quite strong?—Yes.

7995. And your appetite good?—Yes.

7996. Afterwards you became very ill, did you not?—Sometime after that in June, six weeks after.

7997. Had your party turned to come back by that time?—On the 18th of May we turned back.

7998. Then it was on your way back that you became very ill?—Yes.

7999. Do you know what loads the men were dragging when they started from the "Alert" on the sledge journey?—240 lbs.

8000. Did you do double-banking?—Yes, sometimes.

8001. But not as a rule?—No, not as a rule.

8002. Had you a complete sledge party to each sledge?—Yes.

8003. Did you carry any boats?—We had no boats; only the collapsable boat, small canvas boats.

8004. Did that 240 lbs. become less as you got on further?—It got less for about ten days, and then it was made up to the original weight.

8005. What was that?—240 lbs. when we started.

8006. How do you mean it was made up?—By filling up with provisions for so many days from the supporting sledges which returned to the ship.

8007. After that, how about the weight?—After travelling up till about the 24th or 25th April, we got rid again of some of the weight, but we refilled again from our supporting sledge.

8008. Then you still had a supporting sledge?—Yes, up to the 25th of April, and then they returned to their ship nearly empty, while we continued to the northward.

8009. After that, what do you say about the weights?—After that we began to get gradually lighter, by what we consumed off the sledge every day, and by the occasional dropping of a five-day depôt, to pick up coming back. We gradually became lighter, until we had nothing left at all scarcely.

8010. Did you advance by half loads after leaving your supporting sledge, or did you go with the whole sledge?—We found the snow very deep, and we had to advance, the very next day we left them, by half loads.

8011. Did you continue advancing in that manner for any time?—No.

8012. How many days were you obliged to do that?—I cannot tell you how many days.

8013. After you became ill, did many others soon become ill in your party?—Yes.

8014. They became disabled sooner than you did, I think, and more unfit to drag?—I think there were three of us about the same time became ill, but I dragged a time or two afterwards till I could not drag any longer, and I was then obliged to fall in with the others behind.

8015. When you got to the furthest point reached by Lieutenant Aldrich, how many men were disabled?—None of us were totally disabled.

8016. How many were ill?—There were three others besides myself just beginning to feel the effects of scurvy on them.

8017. But you were all dragging?—Yes, up to that day.

8018. Did the illness commence very much in the same way with the other men as with you, with spots

and weakness first?—They seemed all to come out the same as my own in most of them, on the left leg. Some of them had it in the right leg as well, I think, but the left legs, as a rule, went first.

8019. How did you find out these spots?—I happened to find out mine in the latter end of April by changing my foot-gear at night, when I saw a patch on the calf of my leg, and I concluded that there was something wrong, but I said nothing about it the first day. I thought it was a chafe, or something of that kind.

8020. You felt nothing wrong with yourself before that?—No.

8021. Did all the men change their foot-gear at night?—Yes, everyone.

8022. But no other clothing, I suppose?—Yes, they took off their snow suit.

8023. On coming back the men became very quickly disabled, did they not?—It was a gradual run right from the beginning to the end, from the time we were first taken; but it was towards the last twelve days from the ship that we seemed nearly to come to a stand still altogether, when we met the relief.

8024. You were all ill, were you?—There were two men, Lieutenant Aldrich and a man named Ayles, who were not disabled.

8025. Who came to your relief?—Lieutenant May, and a dog-sledge with three men.

8026. Before he came had you gone to that depôt where you found the lime juice?—Yes, we had been having lime juice for some days then.

8027. The whole party?—Yes, every one.

8028. Did it do them any good?—Yes, I believe it did. Anything would do good for a change, any sort of food that a man could eat, I think, would then agree with me. It would not matter what it was. Anything in the shape of something fresh would do a man good at that time.

8029. You think that lime juice is, to some extent, a food?—Yes.

8030. How did you get back to the ship?—We pitched there, and then, when we sighted the relieving party, Lieutenant Aldrich ordered us to remain there for the night, while he went to see who the party were, and by the time he came back we were camped and the next day they brought a dog-sledge down on to the floe, and began to drive us by threes and fours on the dog-sledge towards the ship.

8031. Then you got to the ship in June, did you?—On the 25th of June.

8032. Where were you put on board; in which part of the ship?—The starboard side of the steerage.

8033. Was that used as an hospital?—Yes.

8034. How many men were at that time laid up with scurvy on board?—A little under thirty, I believe, at that time; about twenty-eight or thirty.

8035. What doctors had you attending you?—Both doctors, Dr. Colan and Dr. Moss.

8036. What nurses were there?—The ship's steward and the ship's cook were attending as nurses when we arrived back.

8037. With thirty cases?—About thirty; some had got pretty nearly well, or were better. I mean in the minor cases.

8038. Did any of them require a great deal of attention?—First of all, I think, we required a deal of attention.

8039. What sort of attention?—Because a man is helpless; he wants help for anything that he requires. He must have some one to assist him. In addition to those two nurses, that I mentioned, there were three others in three watches, night and day, to attend to what any man wanted, and invariably there was one of the doctors, and sometimes both, there night and day.

8040. The doctors were extremely attentive then?—Yes.

8041. Were they very hard worked, do you think?—I do think so during that time.

8042. How long a time was that?—I should say about seven weeks, according to my own experience,

8043. Were both doctors on board the ship during the seven weeks?—Yes.

8044. And both very hard at work?—Yes, they were; their time was all occupied.

8045. And sometimes night and day?—Yes.

8046. Were they the worse for it?—No; I do not think they were.

8047. Had they to do any of the nursing?—Anything that was wanted doing; if the nurse was not handy, neither of them was above doing it.

8048. And they did it?—Yes.

8049. What did they do?—I cannot tell in individual cases; but if, for instance, I was helpless myself, and was trying to get up, and the nurse did not happen to be there, if the doctor could help me to it he would do it; any little case like that.

8050. Some of the men were quite unable to move, or to get up, I believe?—Yes.

8051. And in those cases the doctor had to do everything for them?—The nurses were there to do it, but provided the nurses were not there, the doctor would do it; if the nurse had hold of a man at one end of the deck, he could not be at the other side at the same time.

8052. There was enough to do to keep the doctors, as well as the nurses that were there, fully occupied?—Yes; of course every one gave all the assistance in his power.

8053. Had all those cases in the hospital lime juice daily while they were being treated, do you know?—Yes, twice a day.

8054. You had it, had you not?—Yes.

8055. Did it do you good?—I think it did me a great deal of good.

8056. (*Dr. Donnet.*) When you started for the ship in your sledge, were you obliged to advance by double-manning?—Not when we started, not till some time after we started; we started single-manned, and managed the sledge for several days.

8057. Did you have to double-man your sledge after that time?—Yes, at times.

8058. Will you describe the work that you had to do in this double manning?—On the level, you were single-manned; if the snow was hard, or if it was on the bare ice, then you would do it single-manned; but you would double-man if it was up hill, or a mountain, or a snow bank, when you required every one's strength to the utmost that you could put on, and if you found that you could not do it, you would have to dismount half the sledge and take about half the load off, and then try and drag again, the usual "one, two, three, haul."

8059. I believe you belonged to the sledge "Challenger"?—Yes.

8060. Was it in the month of April that you started?—Yes, on the 3rd of April I believe, if I remember rightly.

8061. I see by the report, that on the 8th of April, that was your sixth march, you started double-manned?—Very likely in that one case we did; about the 8th of April, I now remember, we double-manned for days together. I cannot say exact dates.

8062. How many were in your sledge party?—One officer and seven men.

8063. Do you know what the weights were that you dragged at the time?—About 240 lbs. each.

8064. What was the work which you went through in dragging; can you describe it?—It is jolly good hard work; there is only one thing that I could possibly compare it too, so as to describe it to you; it is like about seven horses dragging a plough, as near as possible.

8065. Did you leave your sledge and then return for others?—We were, at the time you are speaking of, at Cape Joseph Henry, where we parted with the Northern party who went across the ice, and we continued to the north-west with the "Poppy" sledge. Up to the 25th of April we were accompanied by the "Poppy."

8066. Did you perspire much during this work?—Yes, very freely.

8067. Did you suffer during the halt when you were obliged to stand still?—No.

8068. Did you find it very cold?—Yes, but we used to keep on moving as long as we were able to do so.

8069. Do you think that the marines and the blue-jackets were equally able to do the sledge work?—I do, for a certain time.

8070. As a non-commissioned officer, had you the choice of a sledge party, would you take marines, or blue-jackets in preference?—I have no choice in the matter at all.

8071. You think the one as good as the other?—Yes, at dragging.

8072. You say that one of your men was exempt from scurvy; what sort of a man was he?—He was a man about 5 ft. 4½ in., I should think; a well set man.

8073. What character did he bear?—A very good one.

8074. Do you know what his habits were?—Yes. He was a very temperate man, having stated himself that he had never tasted intoxicating drink in his life.

8075. Do you think that his exemption was owing to his temperate habits?—No, I can hardly say that; not with any amount of certainty.

8076. You mentioned in your evidence, that you remarked that the left leg was more readily affected than the right; had you any reason for saying so?—We often used to joke about the matter, and I think we came to the conclusion amongst the men ourselves that it was simply this: we used to start with the left leg in the "one, two, three, haul," and we supposed that the weight of the body being on the left leg every time, was the cause of its catching us in the left leg first.

8077. It was owing you think to the greater exercise that the left leg underwent at first?—Yes; I think so.

8078. (*The Chairman.*) When the sick-nursing was going on on board the "Alert." I presume that, as the men became convalescent, they assisted to nurse those who were still sick?—They did.

8079. And I presume that the messmates of the sick, when they had nothing else to do (and I suppose they had not a great deal to do, the ship not being at sea), also looked after their messmates as they usually do?—Not exactly; because, owing to the immense amount of work going on about this time, when we were all sick—that was the time that we were preparing the ship to return home—and owing to the few people that could walk about, the work became very hard for them, simply because there were only a few working hands, and a deal of work to be done to get the ship in readiness, in case the ice did break up; and the work came very hard upon them, so that they had all their work to do; and at night, by the time they left off their work, those men would invariably go and sit down and smoke their pipe, or what not, and go to bed at their usual time.

8080. So that all the men who were fit to work were pretty well employed during the course of the day?—Yes; while the others were lying there sick, because there were very few of them to do it.

The witness withdrew.

MR. GEORGE WILSON EMMERSON, Boatswain, R.N., *examined.*

8081. (*The Chairman.*) Did you join the "Discovery" on the day when she was commissioned?—I joined her, I think, about 14 days before the date of the commission.

8082. And you remained in her until she was paid off, did you not?—Yes.

8083. What was your rating?—Chief Boatswain's Mate.

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8084. Were you captain of a sledge?—I was captain of the "Sir Edward Parry," commanded by Lieutenant Beaumont; and afterwards I was transferred in charge of a sledge of my own, which I christened the "Alert."

8085. Were you captain of a mess?—I was caterer to the mess that I was in, being the chief petty officer of the mess.

8086. How many sledge journeys were you engaged in?—I started from the "Discovery" to the "Alert," I think, about the 20th of April, and on reaching the "Alert," they placed me in charge of a sledge taken from Captain Beaumont, and then I went over to Greenland; and I returned back from Greenland to the "Alert," and went from the "Alert" again to Greenland, and there I fell in with Dr. Coppinger's sledge, and from there I went to Polaris Bay across the plains, and there I was met by Captain Stephenson and taken back to the ship. In the autumn, I think, we only had about two days' sledging. I was engaged in sledging something between 40 and 50 days.

8087. (*Admiral Sir R. Collinson.*) Comparing your accommodation on board the "Discovery" with that of other ships in which you have been of Her Majesty's navy, which had the most room for messing and berthing?—I think that we had everything that we could wish for in regard of our mess on board the "Discovery"; but we suffered greatly with our seats. Our lockers were covered with carpet, and the condensation that was overhead used frequently to drop down and wet the carpet through. The carpet was on the locker the whole of the winter, and it was always wet, and one or two of the men suffered dreadfully with piles through the same thing, I believe, and I suffered a little myself; but I never had treatment from the doctors.

8088. So far as the space goes, was there room for you on the lower deck?—Yes, plenty.

8089. Was there as much as is usual on board Her Majesty's ships?—Yes.

8090. And the berthing for the hammocks was the same?—Yes, exactly the same.

8091. You said that you sat upon lockers. Were they the receptacles in which your clothes were kept?—Yes.

8092. There was no ventilation, then, along underneath the tables?—None.

8093. It was not as if you had to sit upon stools?—No, nothing of the kind, because we could not have the ventilation under the tables, as we would have in an ordinary man-of-war.

8094. Were you ever in any of Her Majesty's ships where you kept your clothes in a position like that?—Never.

8095. You have spoken about this drip; was there very much of it?—Yes, a great deal, and our bedding was always wet. Complaints were being made every day to me, and from me to the commanding officer, and then measures were taken to dry the bedding, which was done very often in the arctic regions. The condensation would drop on the blankets and wet them through; and, in the early part, our hammocks used to be stood upon the forecabin, and the bed would freeze fast to the hammocks. You see, the heat from our body would strike through the bed, and the hammocks would not allow it to pass through, and the beds used to freeze fast to the hammocks. I have called the attention of the commanding officer to it, but of course you could do nothing more, than have them dried. There used to be a sheet of ice between our bed and our hammock, until we stowed them down in the main hold. We cleared out the main hold, and took the provisions on shore, and put the hammocks down below.

8096. Were your hammocks painted or not?—They were painted, generally. Some tried hammocks that were not painted, but the same thing occurred with those hammocks as did with the hammocks that were painted.

8097. Was any attempt made to check this drip-

ping?—Yes; there were uptakes placed in different parts of the deck, but that did not stop it.

8098. Have you any suggestion to make as to what would stop it?—I could not, indeed. I believe that everything was tried. No matter who thought of any plan to stop this condensation from the dripping, it used to be tried, but we could not stop it.

8099. Had you a house over your hatchway?—Yes, we had a partition built over the hatchway, and it used to be cleared every morning. It used to be coated with ice, so that if we did not knock it off every morning, we could not get down the hatchway.

8100. Passing on to the provisions, what is your opinion of the provisions that were issued to you on board the "Discovery"?—I have been at sea now fifteen years, and I must say the truth, that I never had worse salt provisions since I have been going to sea.

8101. In the salt provisions do you include the pork?—I include the pork and the beef.

8102. Had you any complaint to make of any other kind of provisions?—None whatever.

8103. With respect to the quantity, had you sufficient to eat?—More than we could eat.

8104. Notwithstanding that, you did not like the beef and the pork?—We could not eat it. I speak from experience. I have been in Her Majesty's service now twelve years, and previous to that I was three and a half years in the merchant service, and I never had such salt provisions in all my life as we had on this expedition. It was not made known to the captain that we could not eat it for a long time. We used to have preserved meats, which, of course, would be fresh, served out, I think it was every other day, or something of that kind, or four days a week, and we used to make one day's allowance last two days, until it came to the captain's ears, and when the captain found out that we could not eat the salt provisions he gave us fresh provisions in lieu.

8105. You obtained during the winter a considerable supply of musk oxen, did you not?—Yes.

8106. Did you like the musk oxen?—Yes. When they were young we could eat them and relish them, but the old oxen used to be very strong, and we could not relish the meat at times.

8107. Did you take your lime juice during the winter regularly?—I do not believe that there was a man in the whole expedition but what looked for his lime juice as a beverage, and used to build upon the time that he would get his lime juice, and always drank it, and they could always drink more at the time.

8108. In what condition were your shipmates at the close of the winter as to health?—In excellent condition.

8109. On your journey from the "Discovery" to the "Alert" had any of your men to fall out from the drag-rope?—On one or two occasions there were two fell out, merely through stiffness in the leg, but after about the third day they were all right again.

8110. Have you any recollection as to the weight which you were dragging on that occasion?—Something like about 200 lbs. I do not think that it exceeded 200 lbs.

8111. You took six days, did you not, to go from one ship to the other?—We took more. I think I can speak for certain, that it was eleven days or over.

8112. Whom were you under on that occasion?—Captain Beaumont.

8113. On your arrival on board the "Alert" you were appointed to take charge of a sledge of your own, were you not?—Yes.

8114. And you crossed over to Greenland?—Yes.

8115. Have you any impression on your mind now as to the weight which you dragged on that occasion?—I think it was about 240 lbs. or 250 lbs. a man.

8116. How many days were you crossing over?—I think four days.

8117. And you came back light?—I came back light in two days.

8118. Then what did you do?—I then took a dépôt over to Greenland, to Repulse Harbour, and there I met with Dr. Coppinger.

8119. How many days were you going there?—Three days, I think.

8120. What were the weights that you dragged on that occasion?—Something like 240 lbs., as near as I can judge.

8121. Had you, in crossing Robeson's Strait, any occasion to unload your sledge?—Only on one occasion, and that was when we got lost in a mist. It came on a very heavy glare and a kind of fog, and I lost my road. I could not tell whether I was advancing to the east or the west side. I could not tell whether I was north or south, and I came to a large barrier of ice, and I dismounted, and carried everything to the top of it, and then pitched my tent. That was on the return, not on going over to Greenland.

8122. Then, although you were dragging 240 lbs. a man across Robeson's Strait, you never had occasion either to unload or to double man?—Yes; on one or two occasions we double manned going from the west side to the east, that was, to Greenland.

8123. That was when Lieutenant Beaumont was starting?—Yes; when Lieutenant Beaumont was in command of the whole four sledges, we double manned them in a certain part of the channel.

8124. But it was not the constant practice all day?—It was not.

8125. On your arrival in Polaris Bay whom did you find there?—I found Captain Stephenson, Lieutenant Fulford, Lieutenant Conybeare, and the other sledge party.

8126. Then you followed Captain Stephenson from the "Discovery" to Polaris Bay?—From Polaris Bay to the "Discovery."

8127. How did you get to Polaris Bay?—I crossed the plains of Greenland between Repulse Bay and Polaris Bay. I crossed from Repulse Harbour; we went through that land and down through Newman's Bay, and then crossed the plains of Greenland, and came out in Polaris Bay. There we found Captain Stephenson and the other officers of the other parties encamped, and we got a fresh supply of provisions from them, and we proceeded to the "Discovery."

8128. How did you find your way from Repulse Bay to Polaris Bay?—I was under the command of Dr. Coppinger.

8129. Dr. Coppinger was with you?—Yes; and there we took the American records and instruments. We took them from Newman's Bay, the principal part of them.

8130. In those sledge journeys which you made, did you carry any lime juice?—None whatever.

8131. When you got to Polaris Bay, did you get any?—We did not.

8132. Were any of your men attacked with scurvy?—Two men.

8133. When were they attacked?—They never complained, and I never heard a man complain the whole time that we were travelling.

8134. Consequently, from the time you left the "Discovery" until you returned to her, the men under your charge had no lime juice, and they were not incapacitated from work?—No.

8135. They returned three times to the "Alert"?—Yes, but they were different crews. Of the men that I took with me in the first place, one or two were taken from me, and placed with other parties. I returned with an inferior crew, those who were sick or injured, and they were left in the "Alert."

8136. And then you had fresh men?—Yes; then I had fresh men to take over a dépôt for Captain Beaumont and for Dr. Coppinger, and my own provisions; then I joined Dr. Coppinger, and returned from Repulse Harbour to Polaris Bay.

8137. Were those three later journeys, the whole three, performed with the same men?—The whole of the men were travelling, but by different commands.

8138. You returned to the "Alert" from Greenland, I think, with an eight-man sledge with invalids on it?—Yes, I had two.

8139. Then you had a fresh crew put on board then?—Yes, but only two sledges. I took back an eight-man sledge to Greenland, and I turned the sledge over to Dr. Coppinger, and the crews were equally divided according to strength. I took from Dr. Coppinger a four-man sledge, and Dr. Coppinger took charge of an eight-man sledge, with six men including himself, and I took a five-man sledge including myself.

8140. What was the date of your return to the "Discovery"?—That I cannot say; I think it was the 9th May.

8141. You came back to the ship with all the men with you belonging to the "Discovery," or did any belong to the "Alert"?—None; they all belonged to the "Discovery."

8142. Can you tell me nearly how many days those men had been travelling with you altogether?—About forty days.

8143. And when they went on board the "Alert," did they get any lime juice?—They did, and champagne too.

8144. So that they had lime juice occasionally?—They had as much lime juice as ever they could consume when they went to the "Alert."

8145. Can you remember how long a period elapsed without those men who were under your charge getting any lime juice at all?—About 25 or 26 days.

8146. At the end of those 25 or 26 days, you arrived on board the "Discovery" with four men and yourself?—I brought over an eight-man sledge, and I had to drag that sledge; and 13 men; but we had other tents and sledge gear divided amongst us.

8147. So that upon your return to the "Discovery," it was in company with 13 people?—Yes, with 13 from Polaris Bay, Captain Stephenson commanding.

8148. I wish to ask you this question: there were four men who were with you 26 days, I think you say?—Yes, without lime juice.

8149. What was the condition of those men when they got on board the "Discovery"?—One man went on the sick list with scurvy, a second man was told off for another sledge party, and I think about the third day after leaving the ship he had to be placed upon the sledge with scurvy; at least, I believe it was scurvy; it was the same complaint that every one else had, and I really think it was scurvy. The other man was only on the sick list, or laid up, for about three days.

8150. Was that with scurvy, too?—I suppose it was from the effects; but, for myself, I had nothing. When I got back to London, I was bad about four or five days with scurvy. My hands were swollen, so that directly I would press my thumbs on my hand, it would leave an impression for about an hour. It swelled so that I could scarcely get on my flannels; and as to my feet, I could not get my shoes near my feet; in fact, I could not get a slipper or a sock on.

8151. Were you treated by a doctor then?—No, I merely treated myself with vegetables and good living with my friends. It was during the time that I was on leave.

8152. Were you on the sick list on your arrival in England?—No.

8153. Did the symptoms break out after you had got on shore?—Yes; after I had been a week on shore.

8154. (*Admiral Inglefield.*) Did you hear much talk on the lower deck about this outbreak of scurvy?—Very little indeed.

8155. During the winter months, I presume that the possibility of the men getting scurvy may have been the subject of conversation?—We had one man very bad. I was never let know what the man was ill of; a man by the name of Shepherd.

8156. Was that before the sledge parties started?—Yes, before the sledge journeys; it was in the winter.

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8157. Was he on the sick list?—Yes.

8158. You know, now, that it was scurvy, but the doctor did not pronounce it to be so then?—He did not pronounce it to be such at the time.

8159. Do you think they knew it was scurvy?—I believe the doctor knew exactly what it was, but he would not allow anyone on the lower deck to know what it was; in fact, he would not allow the man himself to know.

8160. Were the symptoms exactly the same?—Yes, the symptoms were exactly the same.

8161. Was he a man that used to take lime juice?—Yes, he was the man who used to mix it.

8162. Therefore he took a fair quantity?—Yes, he took his fair quantity.

8163. Do you think that the damp on the lower deck had anything to do with the outbreak of scurvy?—I do not think it had.

8164. Have you been able to attribute the outbreak to anything occurring on the journey?—I have not.

8165. The deck was very damp, was it not, during the winter months?—Very damp indeed.

8166. And you suffered, I suppose, as much from the dampness as anything?—More from the dampness than from anything else.

8167. You complained of the salt beef and salt pork, but was there any other food that was disliked by the men?—Nothing whatever that I know of; every else was very good.

8168. The Sergeant described to us that the men did not like the collops?—Yes, the collops were very bad.

8169. What was there bad about them?—In the first place they had no taste. I cannot say that it was food at all, because there was no substance in it whatever, and no man could eat it.

8170. What are they made of?—I am sure I do not know what it is; it is more like chopped liver than anything else.

8171. That was the only kind of preserved meat that was bad, I believe?—That was all.

8172. Did the men cook many puddings?—Yes.

8173. Did they like their dough days?—Yes, we used to have plenty of flour, and we relished the flour more than anything else.

8174. The flour was issued to the men every fourth day, was it not?—Yes.

8175. I see that, according to the printed scale, nine ounces of flour, and one and a half ounces of suet, and one and a half ounces of raisins (those were for making puddings) were issued on Wednesdays and Sundays, every third and fourth day; is that the case?—Yes, that is the case.

8176. And the men appreciated it very much too?—Yes.

8177. With regard to the issue of tea and rum, to which do you attribute the greatest advantage in travelling?—As a drink rum, whilst actually travelling, is a mistake; tea is preferable to rum whilst travelling; but when in your sleeping bag, and want to go to sleep, then you drink your rum.

8178. And it is really useful then?—It is indeed.

8179. It puts you to sleep and gives you a glow?—Yes, it makes you very warm by taking rum in your tea.

8180. How often did you have tea served out in a day's sledging?—Twice a day, once after about five hours' travelling, and once in the evening.

8181. If you were required to go upon another sledge journey, can you suggest any different arrangement of diet?—No, I cannot.

8182. What do you think about the age of the men that are employed in arctic service?—I do not think you could have got a better class of men.

8183. Moderately old and moderately young, I suppose, are about the right mark?—They were about the right mark.

8184. What was the opinion of the men on the lower deck with regard to the compressed vegetables?—They did not care much about them.

8185. The preserved vegetables?—They liked them very well in soups.

8186. Was chocolate drunk freely amongst the men?—Yes, but tea was preferred.

8187. Was any preserved milk issued on board?—Yes.

8188. What quantity?—There were many tins distributed about the lower deck from the ward-room, on our return to England; not before.

8189. This beef, I think you said distinctly, you considered the worst beef that you had ever tasted in the service?—Yes.

8190. And this was mainly owing to its being so salt and so hard?—Yes.

8191. When was it first discovered that it was so bad?—First by the cooks; there were a few remarks passed on it, and then they said it was merely our fancy, as we had been living on fresh provisions.

8192. Why did not the petty officers go on the quarter-deck before the "Valorous" left you, and ask for a survey of it, and get it exchanged?—Because we had had very little salt provisions issued.

8193. I have heard that there was a trial made to get the "Valorous" to take it, and they did not care to have it; do you know anything about that?—I never heard of that.

8194. Upon the whole, do you consider that the beef, which was due to the men according to this ration once a week, as a rule, was not taken up by the men?—It was not taken up as a rule.

8195. Then, in fact, you cannot attribute the sickness or scurvy to the meat being so bad, because it really in good truth was not eaten?—It was not eaten.

8196. Bad as it was it might have been a drawback if you had remained a long time in the arctic regions and had been obliged to take it?—Yes.

8197. But as regarded the effect on the ship's company it was nil?—Yes; we never ate it.

8198. And, therefore, it did nobody any harm?—No.

8199. In what way did you think the salt pork was bad?—Because it always tasted fishy.

8200. Was it too salt?—No; the pork was very nice, but it tasted fishy.

8201. Was it what they call streaky?—Yes; streaky pork.

8202. And ordinarily as good as the general ship's pork?—No, not so good.

8203. The opinion on the lower deck and your opinion was, that the salt provisions were not so good as are usually supplied to ships in Her Majesty's service?—Just so.

8204. (*Dr. Fraser.*) About what time was it that your captain, Captain Stephenson, came to hear that the salt beef was not good?—It was after we had been in our winter quarters for some time.

8205. After Christmas?—I am sure I cannot say whether it was before Christmas or after Christmas.

8206. And while it was being issued the men would not eat it?—No.

8207. Did they take their rations?—No, they left them behind; refused them.

8208. Was the meat cooked all the same?—No.

8209. What was eaten on those days instead?—We used to have our fresh provisions served, the tinned meat, and we used to make one day last two days on these occasions.

8210. That was once a-week?—Once a-week; and then we used to have to make one day's or two day's last three days in regard to the meat.

8211. Then you went on half-rations for one day?—Yes; we did.

8212. Once every week?—Once every week, until it came to the captain's ears.

8213. And then you had the preserved meat increased in quantity, I suppose, to make up for the salt beef?—Yes.

8214. And in reference to pork; did you eat it always, or not?—Sometimes we would take the pork, and at other times we would leave it behind.

8215. How many days in the week did you get pork?—About once, I think.

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8216. Was that the only meat on those days?—That is all.

8217. And was it a general thing among all the messes not to eat the pork on the day it was issued?—Yes; it was a common thing on the lower deck; only when we were very hungry we would eat a little of the pork; but still it tasted as if it had been fed on fish.

8218. Did this pork continue to be issued during the time you were in the winter quarters?—The pork was there; you could have it if you wished.

8219. The beef was stopped?—Yes.

8220. Was the pork stopped too?—No.

8221. There was one day in the week in which the pork continued to be issued through the winter?—Yes; and about one-half of the lower deck would take it, and one-half would leave it behind.

8222. What did the half do who left it behind?—They would simply leave it behind; we could not eat all our allowance; rather than waste food we would leave it behind. Only those who actually took the pork from the steward would take it to the cook, but in the case of those who left it behind, the pork would still remain uncooked.

8223. (*Admiral Inglefield.*) Were savings paid?—No, no savings were paid.

8224. (*Dr. Fraser.*) Then was the meat thrown away that was not eaten?—No, but it was sometimes eaten cold. In some cases the meat was cooked, and reckoning that there are six messes on the lower deck, three messes would take pork; that would be divided among the six messes, simply because we could not eat all our allowance.

8225. The minced collops were not good, you say?—No.

8226. And the ox-cheek?—The ox-cheek was very good.

8227. You heard no complaints of that?—No.

8228. Was it generally eaten?—Yes.

8229. Were the minced collops eaten?—No.

8230. Did the men take up their rations of them?—No.

8231. What did they do with it?—Leave it behind.

8232. Not cooked?—Yes.

8233. What did they eat instead?—We used to have half our rations minced collops and half preserved meats, so we used to make the preserved meats do for the dinner, until it came to the captain's ears, and then it was stopped.

8234. The rations that were served and not eaten, till it came to the captain's ears that some things were bad, were minced collops and pork to some extent, and the salt beef entirely?—Just so.

8235. And there was nothing until the captain heard of it given as a substitute?—No; as soon as the captain heard he gave us redress.

8236. And were you hungry during that time?—No.

8237. You did not feel the want of these things?—No.

8238. The men did not generally?—No.

8239. I think you told us that a man was ill during the winter; that was Shepherd, I suppose?—Yes.

8240. How was this man employed on board the ship?—Captain of the hold and ship's cooper.

8241. Had you anything special to do with him?—I had charge of every man; I was the chief boatswain's mate, and had charge of every man in regard to the duties.

8242. It was early in January, I think, that he became ill?—Yes, in the early part of the month.

8243. In the early part of January, soon after Christmas?—Yes.

8244. Was he perfectly well before then?—Yes, perfectly well.

8245. A strong man?—That I cannot say. In the autumn we had an occasion to sledge for musk ox; I was in charge of the sledge, and the man could not walk; he could not drag the sledge; in fact we had to drag him with us.

8246. He was not strong in the autumn before this winter?—He was not.

8247. Did you know the habits of this man well?—Yes.

8248. Was he a steady man?—He had been a cooper in a brewery previous to joining the service.

8249. And what do you infer from that?—I believe that they are given to drinking a great deal of malt liquors, and I believe, by what the men told me, that he had been a great drinker in his time; still, on board the ship, he only had his stipulated allowance, the same as any other man.

8250. How long had he been in the service, do you know?—Not many years.

8251. You do not know how many?—No, I do not; not exceeding ten.

8252. Between the autumn and this illness in January, I think you have said, he was perfectly well, so far as you know?—Yes; he was used to work on the ice.

8253. He was employed under the steward, assisting the steward?—Yes.

8254. Do you think he might have any opportunity of taking drink, should he wish it, more than the other men?—No; I do not think he had.

8255. You have no reason to suppose that he did drink on board ship?—No; I never saw the man the least worse for drink during the whole time he was in the ship, and he was always under my eye.

8256. Do you know if he always had a good appetite?—No; I do not think the man ever had such a very good appetite.

8257. Do you mean that you remarked that he had not a good appetite?—No; I did not remark that he had a bad appetite.

8258. There was nothing special about him in that respect?—No.

8259. And do you know that he had scurvy?—I fancy he had; I should be sorry to say so for certain. He was very ill, and he was drawn up to double, the same as those men who had the scurvy.

8260. You have no reason to believe that this man did not always take his lime juice?—I believe he did; in fact I have always seen him drinking lime juice.

8261. Can you tell me anything you have ever heard about his being particular or otherwise in his feeding?—I believe he was a very particular man in regard to his food.

8262. How?—He would often eat a certain part of his food, but he would never make it known what he used to relish and what he could not relish. Sometimes he would go in the mess and have his dinner; other days he would leave the mess and not have his dinner.

8263. Was that before January?—I cannot say. I cannot recollect so far back; but during the time that he was ill he would not eat food at all for some time; in fact the doctor called me and told me that if he did not eat his food he would have to take other means.

8264. Was he fond of vegetables?—Yes, he was very fond of vegetables, and used to eat them, especially onions.

8265. How often had you potatoes on board during the winter?—In our mess we had them every day.

8266. That is the petty officers' mess?—Yes; but we had the same amount of rations as any one else, but we were very small eaters, and our rations used to last us twice as long almost as other people's.

8267. How often were potatoes issued to the men generally?—I think about three times a week.

8268. Did the men like Edwards's potatoes?—Yes, as a rule.

8269. You got a good deal of game, I think, did not you?—Yes.

8270. Was it in the winter?—No, in the summer or spring.

8271. You mean the spring in which you had all the great sledgings?—No, after our sledgings.

8272. It was last year, was it, or the year before?—We only had one sledging, and after our sledging those men who returned from the sledging would go hunting in the evenings; that is where we got the game.

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8273. Just before you came back, you mean?—Yes.

8274. Had you not much game before the spring sledging?—No.

8275. Had you any?—Not on the lower deck.

8276. Was there no ration of game issued on the lower deck from the time you commenced the winter until the sledge parties went away?—Occasionally, for the sick.

8277. But no general issue?—No, not that I can recollect.

8278. Do you include musk ox in what you say?—Musk ox was issued daily.

8279. When?—Through the winter, twice a week.

8280. You do not call that game, then?—No, I do not call it game.

8281. You had a great deal of musk ox, I think?—Yes, a great deal of musk ox.

8282. Shot during the winter?—It was shot during the autumn and spring, after our sledging.

8283. Had you any other fresh meat in winter?—Yes; Christmas Day we had mutton, what we took with us from England.

8284. Did you shoot anything else, in autumn or winter, besides musk ox?—One or two ptarmigan, and I think about half a dozen hares.

8285. What do you mean by "game"?—Such as hares; and then of course we shot ducks and geese.

8286. All that was after the sledge parties?—That was after the sledging.

8287. The musk oxen were not very much liked?—No; the old oxen were very tough; the young oxen were very tender and very nice eating, but all lean.

8288. And were the old ones eaten by the men?—Yes, the same as the young ones, when served out for rations.

8289. You had only two days' sledging in autumn?—Two days.

8290. What kind of rations did you carry?—We carried pemmican, bacon, rum, biscuit, tea, and chocolate.

8291. The ordinary sledge rations?—Yes, just the ordinary sledge rations.

8292. You had 30 or 40 days in spring?—Yes.

8293. And the rations were the same?—Yes.

8294. Did you carry any lime juice in the autumn?—No.

8295. Nor did you in the spring, I think?—No.

8296. Were you quite satisfied with the ration that you carried in the spring?—Quite; it was more than we could eat.

8297. Do you think you had enough of biscuit?—No, not enough biscuit.

8298. Then you suggest that it would have been better had the biscuit been increased in quantity?—Yes, we could have eaten more biscuit.

8299. You found the pemmican more than you could eat?—Yes, too gross; we could not eat more than half allowance.

8300. Heavy feeding, was it?—Very heavy.

8301. Would you prefer to have the bread increased rather than the potatoes increased?—Yes, we should prefer the bread; we look for bread when we should not look for potatoes.

8302. Had you enough potatoes with you?—Plenty.

8303. As much as ever you cared to eat?—As much as ever we cared to eat.

8304. The ration, however, of the potatoes was rather smaller than that, on board ship?—Yes.

8305. You found that you could eat more potato on board ship than you could in sledging?—Yes, we could.

8306. Were you at Polaris Bay?—Yes.

8307. Was that when the men were ill of scurvy?—The men who were ill with scurvy arrived at Polaris Bay after I had left for the ship.

8308. Did you see the lime juice there?—No.

8309. Did you eat or drink it?—No.

8310. You yourself were quite well at that time?—Yes, I was quite well.

8311. I think you have told us that four men accompanied you for some 26 days?—Yes.

8312. That of these men three took scurvy?—Yes; one man took scurvy and another man left me, I think, about two days afterwards, and sledged from our ship to the "Alert," and had to be placed on the sledge suffering from scurvy or some other complaint so that he could not walk.

8313. And what became of the fourth man?—He was all right.

8314. What was his name?—Stone.

8315. Did he afterwards take scurvy at any time?—That I cannot say; I do not recollect.

8316. You were quite well until you came to this country, were you?—Yes, until I went home to be with my brother in London, and then I was bad about four days; my feet swelled, and my ankles swelled very much.

8317. Were you very weak?—No, I was not very weak, but still I did not have the same strength as I used to have. I used to be a very strong man.

8318. Had you any pain?—No pain, just merely a little stiffness in the sinews.

8319. I suppose that you had not a great many cases at one time on the "Discovery," had you?—Yes; I think there were about ten or twelve in the sick list at one time.

8320. Not more than that?—Not more than that, I do not think.

8321. That includes some men who wintered in the "Alert," I think?—Yes; that was including the man who was sledging with me; his name was Hindle.

8322. (*Dr. Donnet.*) On your return to England you say that you suffered from what you consider to be scurvy; did you likewise suffer from cold or cough?—A very bad cough.

8323. Did all the ship's company suffer from that cold likewise?—I do not know. I am sure; I suffered very much from a bad cough whilst in the arctic regions.

8324. On your coming to this climate did you not suffer from cold?—No; only from cough.

8325. You say that the beds were wet before they were stowed in the hold of the "Discovery"?—Yes.

8326. Did the men suffer from wet beds?—No.

8327. When the sun returned were the men in very good condition?—Yes, apparently.

8328. Do you think that they were fitted for the duties which sledge travelling requires?—I do.

8329. You spoke of the salt meat being bad; did you think that the provisions as a rule were inferior to the provisions served out generally in the royal navy?—No; I think that the food was very good indeed, but that the salt beef was very bad indeed; we could not eat it.

8330. You mentioned likewise the salt pork?—The salt pork tasted fishy always.

8331. Did many of the men object to take the salt pork?—Yes, a great many.

8332. As chief boatswain's mate you were in a position to know whether many did refuse it?—Yes.

8333. Did they give the same reasons that you have given?—Yes; always spoke of its being fishy.

8334. Did the men ever represent to their captain that they would rather not have salt meat, but would prefer preserved meats?—I almost forget how it was represented to the captain; I would not like to speak for certain.

8335. In your position as chief petty officer you must have had means of knowing?—Yes. Directly it was spoken of there were more provisions allowed for the lower deck.

8336. Do you think that the men were sufficiently well provisioned?—Yes, very well indeed. I never lived better all my time in the service than I lived in the "Discovery."

8337. Are you fond of preserved meat generally?—No; I am very fond of beef.

8338. You say you did not like the salt meat, what animal food did you live upon?—I lived princi-

pally upon preserved beef and mutton, musk ox, and hares, when I could get them.

8339. You lived therefore only on preserved meats?—Only on preserved meats.

8340. Did you never touch the salt beef and the corned pork during the whole time you were in the expedition?—Yes, I touched it a few times before the winter came on, but in the winter I never touched it; and I never touched it from about three weeks after we got into winter quarters to the day of reaching England.

8341. Did the men like musk ox?—Yes, they used to look for it, and build upon the days that it would be issued as a ration.

8342. Did you eat every part of it, the liver and kidneys?—Yes, we used to eat the liver and kidneys.

8343. Did you find that the liver and kidneys were more musky than the flesh?—No, as sweet as any you would get from an English bullock.

8344. You mentioned that the old musk ox was not as good as the young one?—No.

8345. Was it more musky?—Yes.

8346. And was it likewise tough?—Yes, very hard.

8347. You say you were in the merchant service?—Yes.

8348. What time?—In 1862 and 1863.

8349. Was the lime juice served out to you then good?—We only had lime juice, I think, about once; that was on our voyage from England to Calcutta.

8350. Was it served out immediately you left England?—No, after we had been from England about fourteen days.

8351. And was it given to you every day?—Yes.

8352. Up to the time you reached Calcutta?—Up to the time we reached Calcutta, and then stopped.

8353. In the other ships you served in, did they likewise follow the same precautions?—Not in the merchant service; that was the only ship I had lime juice in; the others were in the Baltic trade, and no lime juice was issued.

8354. What time were you away from England in

these Baltic cruises?—Two or three months. I was frozen up in Viborg.

8355. Did you carry an abundant provision of vegetables?—Yes; we used to carry a great deal of vegetables, such as potatoes and cabbage.

8356. Fresh?—Yes.

8357. Was it for that reason that lime juice was not supplied then?—I think so; but I was quite a boy then, and I cannot speak about it.

8358. Do you know why lime juice is given to men on a long sea voyage where fresh provisions are not supplied?—I have heard that it is to keep down scurvy, to counteract the salt food.

8359. Do you know what the opinion of the men generally in the merchant service is about lime juice?—They always look very anxiously for it.

8360. As a pleasant beverage, or as a preventive of scurvy?—As a pleasant beverage.

8361. Simply as a pleasant beverage?—Yes.

8362. Do you know what the men of the "Discovery" thought of lime juice?—We were always anxious for the time to come when it would be issued. Working over ice, we always looked for the lime juice to be issued.

8363. That was only in the summer season, I suppose?—In the winter season.

8364. Did you ever hear the men speak of the outbreak of scurvy on your return to England?—No, I did not.

8365. As you had cases of scurvy, it would have been natural for the men to ask why that scurvy had broken out?—I never heard it mentioned.

8366. Have you any opinion yourself about the causes that produced this outbreak in the late expedition?—Nothing more than hard work, and the want of vegetables and blood meat.

8367. Do you allude to the sledge parties or to the ships?—To the sledge journeys.

8368. What do you mean by "blood meat"?—If we could catch an animal of any kind, so that we could have fresh meat with blood in it, I believe that it would keep the men clear from having scurvy.

The witness withdrew.

MR. WILLIAM JENKINS, *examined.*

8369. (*The Chairman.*) When did you join the "Discovery." Two days before she was commissioned.

8370. And in what capacity?—Carpenter's Mate.

8371. Were you captain of a mess?—Yes.

8372. In how many sledge journeys were you engaged?—Only one. I was in the journey of Captain Beaumont; that is the only sledge party that I was with. We went from the "Discovery" to the "Alert," from the "Alert" to Greenland, then on the exploring expedition, and then we returned.

8373. (*Admiral Sir R. Collinson.*) Where did you sleep on board the "Discovery"?—I slept on the lower deck.

8374. Whereabouts?—As near as possible amidships.

8375. Was it as comfortable a berth as you used to have on board the other ships that you have been in?—Yes, very comfortable; built very comfortable, indeed.

8376. As much room to swing the hammock in as you would have on board any other vessel?—Yes; in fact more.

8377. And did you suffer much from the damp over head?—Rather. I very often was forced to put my oilskin over the hammock to keep the water from dripping in the hammock.

8378. How do you think that could be prevented?—I could not say, without we had a double upper deck; that might be a preventive. I do not think there was any possibility of preventing it as we were situated.

8379. Now, with respect to your messing, had you as comfortable a mess-place as you would have had any where else?—Yes; very comfortable.

8380. Were the provisions as good as what you generally got on board Her Majesty's ships?—I think rather better; only it was the same thing nearly; it was preserved meat over and over again; it was continually preserved meat, with a change of different assortments.

8381. Did you like the salt meat?—I do not think I ate two pounds of salt meat during the expedition.

8382. Was that because you do not generally eat salt meat, or was it that you did not like this?—I think the salt meat we had was rather highly salted, the beef especially; and, as we were situated, I heard many saying that it was bad to eat salt meat, and I never did eat any, and we generally had a little spare stock of preserved, and I made use of that in lieu.

8383. And was the pork good?—The pork was very good, better than I have ever had since I belonged to the navy.

8384. (*Admiral Inglefield.*) Had it no fishy taste. Not what I had.

8385. Did you ever hear other people say that it had?—Yes, I did.

8386. (*Admiral Sir R. Collinson.*) Did you take your lime juice regularly?—Regularly. I took my full allowance of everything I was supposed to take.

8387. Do you like lime juice yourself?—Yes, perfectly well.

8388. When you went away to go to the "Alert," did you take any lime juice with you in the sledge?—No.

8389. Did you get any when you were on board the "Alert"?—Yes.

8390. While you were stopping there?—Yes.

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8391. And when you left to go to Greenland, did you take any with you then?—No.

8392. And when did you begin to feel knocked up?—The last day of our march out, our outward bound march; not knocked up then, but feeling symptoms of scurvy.

8393. Just tell the Committee what you did feel?—I felt pains in my thighs first, and from there to the back of my knee; it seemed to be drawing my legs up so that I could scarcely bend them. I could not straighten them, nor yet bend them any more than the position they really were in.

8394. And you were at last not able to drag?—I was at last not able to drag; then I walked as long as I could, and then I was forced to be carried.

8395. And how many days were you carried before you got into Polaris Bay?—I do not think I could exactly tell.

8396. Three or four?—More than that, but I could not really tell.

8397. When you arrived at Polaris Bay, what was done to you?—We had plenty of lime juice there, and the preserved rations and the game that they shot there; very good treatment.

8398. Had you difficulty in eating at that time?—While I was bad I had no appetite at all; I could not touch the pemmican.

8399. On your arrival at Polaris Bay what did you take a fancy for?—Wild duck, and made a very good meal on it.

8400. Did you like the seals' meat?—Yes; very much.

8401. And what else?—I liked the seals' meat, and ate a great amount of it, and the ducks and geese that the officers used to shoot; and then we had preserved meat of different kinds.

8402. You did not care about the preserved meats?—Not while we could get the fowl or seal.

8403. Did you there get the American lime juice?—Yes.

8404. Did you take much of it?—Yes; an extraordinary amount, after being so long on pemmican.

8405. Were you left by Captain Stephenson at Polaris Bay to come over with Captain Beaumont?—No; I crossed with Captain Stephenson. I got back to the ship some time in August; what date I could not say.

8406. What condition were you in?—Not able to drag, but just able to walk across at the rate that they dragged the sledge across.

8407. You had improved then very much?—Very much, because I was not able to walk when I arrived in Polaris Bay, and Captain Stephenson stopped in Polaris Bay a week, and by that time I had improved very much.

8408. How long were you in the list after you got on board the ship?—About seven or ten days, I could not be certain which; not very long before I was put on light duty and work at my own trade.

8409. And you got quite well?—Yes; quite well.

8410. (*Admiral Inglefield.*) Did the travelling give much pain when you were on the sledge; when you were obliged to be dragged by your shipmates, did that give you much pain?—Yes.

8411. The jogging?—Yes; very much, indeed.

8412. Had you ever the sort of feeling that you would rather be left behind?—Yes, I had, many a time.

8413. Left behind to take your chance, and not be dragged on?—Yes, I had that feeling many a time.

8414. What had you a craving for when you came to Polaris Bay; for fresh meat?—Yes.

8415. And lime juice?—Yes.

8416. Not for vegetables?—Not in particular; anything for a change.

8417. Did your gums bleed?—Very much, and the teeth got loose.

8418. And did patches appear all over your legs?—Yes, like bruise marks.

8419. And did your feet and ankles swell much?—Yes, mine did very much.

8420. Now, what is your opinion about tea and rum? Do you consider tea or rum is the best thing for travelling on?—I think tea, most decidedly, at mid-day, but I think a glass of rum would be very good on turning in at night.

8421. What age are you?—Thirty-three last birthday, Christmas-day.

8422. Then you were one of the oldest men of the party; you must have been thirty when the ship sailed?—Yes.

8423. They were mostly under thirty?—Yes.

8424. Now, the beef was very bad indeed, you say?—Very salt.

8425. The pork not bad?—No.

8426. And what do you think of the collops?—I did not like that.

8427. Why did you not like it?—It was like sawdust.

8428. Nobody liked it?—No, nobody liked it, not in my mess any one.

8429. But as to all the other preserves?—All the other preserves, I think, were as good and better than ever I tasted before.

8430. Was there a great deal of damp on the lower deck?—Yes.

8431. What did you do to get rid of it?—We used to try a fire, and set the stoves alight, and the more the fire burnt the wetter it was. I generally used to sling my oilskin over my hammock to keep the dripping out of the hammock. I do not think there was any preventive for it as we were situated.

8432. You liked your lime juice?—Yes.

8433. Did you do much work in your trade while in the arctic regions?—Yes; we were continually doing something or other.

8434. Mending sledges?—Yes, and on the journey.

8435. Then you carried your tools with you, I suppose?—No; made shift without tools; never carried any; it would have been very serviceable if I had.

8436. You drank all your lime juice regularly?—Yes, all my lime juice regularly.

8437. (*Dr. Fraser.*) You were captain of a mess?—Yes.

8438. What was the number of that mess?—Number 5.

8439. Do you remember a man, James Shepherd?—Yes; he belonged to the same mess with me.

8440. Had he been in tolerably good health until January, when he became distinctly ill?—Yes, I think he was in very good health, but he never was one of the strongest men; he seemed to be rather delicate about his provisions at all times. I do not think he was the strongest of constitutions.

8441. It is because he did not eat much that you think so?—No; he did not eat so much as the general run of the messmates.

8442. Did he seem to have very little appetite before January?—Yes, he did.

8443. What did he eat?—He ate the same as the rest of us; biscuit and cocoa for breakfast, and whatever preserved meat there was for dinner he used to eat a certain amount of it.

8444. Was there anything that he seemed particularly to dislike?—I could not say one thing more than another. He did not seem to be a very strong man, and I do not think he was.

8445. He did not like the salt meat, I think, did he?—No; I do not think he liked it, but I did not, and I did not make use of any, because there was plenty of preserved.

8446. Do you know if he generally ate the vegetable part of his food?—I always ate my part, I am certain of that; but whether Shepherd did or not I never used to take particular notice, but I have noticed him on many occasions very delicate.

8447. What did you notice wrong with him?—I think his appetite was very bad. I noticed nothing else, because he belonged to a different establishment from what I did; he was a ship's cooper, and belonged to the ship's steward's department.

8448. You do not know how he did his work?—I do not know how he did his work. I could not say; I had nothing more to do with him, only while he was at his meals.

8449. Had you something to do with the mixing of the lime juice?—Yes; I used to take my turn as petty officer of the day.

8450. I suppose every man took his lime juice?—Every man took his lime juice; we did for a while serve it out on the quarter-deck. We, for the first of the time, served out every man his allowance on the quarter-deck; then after that, served it out to the messes according to the number of men in the mess, and then every man's measure was measured out, and he drank it.

8451. This man, Shepherd, was never so ill, was he, before January, that you, or anyone else, let him off from taking his lime juice?—I do not remember; I could not say, but I know he was very bad; he was the worst case that we had on the lower deck while on board the ship, any how; and he never left the ship, not to the best of my knowledge. In the winter he was bad, very bad.

8452. How often had you vegetables on board the "Discovery"?—I could not say for a certainty.

8453. Every day?—Every day some description or other; sometimes it was onions, sometimes carrots, and sometimes the mixed vegetable.

8454. The vegetables were always good, were they?—Yes, always good; only the onions I did not care much about; the carrots were perfectly good.

8455. Did you like the compressed cabbage?—The compressed cabbage was very good, but the onions I, for my part, did not think were very good.

8456. How often had you potatoes in the week?—Three or four times; I could not say for certain.

8457. Had you a large quantity each time?—Quite sufficient, I think.

8458. Had you on board ship more or less than when you were sledging, of the potatoes?—We had it every day while we were sledging: we had a certain allowance.

8459. Was it a larger allowance than you got on board ship, or smaller?—I could not say which, but I rather think smaller, although we had it every day while sledging, and we had not on board the ship. I think it was smaller, reckoning every day; but it might have been the same amount, reckoning the number of days that we had it on board ship.

8460. You did not yourself take more than 2 lbs. altogether, you think, of the salt meat?—No, I do not think I did; I am almost sure I did not.

8461. Was that because you had heard that salt meat might produce scurvy?—It was because I did not like it; because I had heard that salt meat was bad for the scurvy, and therefore I thought to make it a preventive, as much as possible, by not eating it.

8462. Is that the reason why so many of the men did not care to take it?—I think so.

8463. Rather more than because it was bad?—It really was very salt; it was beautiful meat, only it was too much salted.

8464. When you were sledging, did you always get plenty of good water?—I could not say about the quality, we had plenty of it; we melted ice, and I rather think there was some of it not too good. I do not know; I am not supposed to be a judge, and do not reckon myself to be a judge of that, because I was inexperienced, although it was melted ice; and I do not think it was very good, not at all times.

8465. What was the matter with it, so far as you know?—There might have been a little saltiness attached to it.

8466. Did you suffer from thirst at all?—While sledging, not on board ship.

8467. I mean while sledging?—Yes, several times; I have many times had to eat a little ice to quench my thirst.

8468. You tasted the lime juice at Polaris Bay, did you not?—Yes.

8469. Was it at all different from what you had been accustomed to?—Yes.

8470. What was the difference?—It was rather a different sort; I think it was rather better than ours, or else we used to get a larger amount mixed with the water.

8471. Stronger, you mean?—Yes, but I think it is very possible that it might be Dr. Coppinger's arrangement to give it to us very strong on the occasion.

8472. (*Dr. Donnet.*) Did you take the same amount of exercise as the rest of the crew?—The very same. I used to work till five bells on the ice, the same as the rest, every day; then I used to follow my profession as carpenter on board.

8473. Did that oblige you sometimes to keep down on the lower deck?—Sometimes, when there was a job of work to be done, I had to do it on the lower deck.

8474. Did you remain for any number of hours down on the lower deck?—No.

8475. You did not suffer from your duties?—No, I did not.

8476. You say that you liked the seal's meat which you got at Polaris Bay?—Yes.

8477. Do you think that it was as good as English meat?—It was, if you did not look at it; it was very bad to look at.

8478. At the time that you got to Polaris Bay you were ill?—All were very bad.

8479. How was your appetite before arriving at Polaris Bay?—Very bad, very weak.

8480. When did you take the seal's meat after arriving at Polaris Bay, was it immediately?—No, not immediately, about two or three days after; there was no seal's meat there when we arrived.

8481. From whence did you get the seal's meat?—The Esquimaux dog-driver that we had shot the seal, and we had the meat. The first provisions that I had at Polaris Bay was wild-duck soup, and I relished it very much.

8482. This duck was shot by the officers, I suppose?—Yes, it was shot by the officers.

8483. Did they shoot many?—Several.

8484. Did you get many geese?—Several.

8485. Did you take the fresh meat and prefer it to anything else which you had at Polaris Bay?—Yes.

8486. Was it from hunger, or from the wish for meat?—From the wish for a change; not from hunger though. I had not eaten pemmican for a fortnight before I arrived there.

8487. What did you take instead?—The preserved potatoes that we had, and the biscuit and tea that we were allowed.

8488. With the fresh meat you likewise took lime juice?—Yes.

8489. Did you recover very quickly?—Very quickly according to medical statements, considering the condition that I was in.

8490. Which do you think cured the scurvy, the fresh meat or the lime juice?—I could not say.

8491. Do you think that lime juice cures scurvy?—No; I do not think it would by itself. I think you would want a change of diet.

8492. Do you know what the men of the "Discovery" thought of the use of lime juice?—I think they considered it very good.

8493. What did they take it for?—For a preventive of scurvy; that is what it was reckoned to be.

8494. Do you know why the scurvy broke out in your ship?—No; I could not say why.

8495. Did any of your men ever talk together about the causes that produce scurvy?—No, never; to the best of my knowledge; it came on me unexpectedly, quite as a strange thing. I never knew anything about it before, and I did not believe that it was scurvy when I first saw it. I never thought of scurvy breaking out.

8496. When you got well, and when you were returning to England, did you not speak to some of your messmates, or to any of the men on the lower deck

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about the scurvy breaking out?—I may have had many a talk about it: but we could never tell what was the reason of it. We generally thought that it must have been the coldness of the weather and the limited provisions without a change.

8497. The limited provisions of the sledge parties, you mean?—Yes; but we had all preserved provisions on board; and after a considerable time on preserved provisions, your stomach gets very much against it, and you cannot eat sufficient, I think, to meet the demands which you are required to meet.

8498. What provisions do you think ought to have been carried on the sledge journeys that could have been carried. I ask you the question, as you have had experience in sledge travelling?—I do not know of anything more than we had, or better than we had; because we were bound to a certain amount of weight, or else we could not have dragged the sledge at all, especially across the roads that we had to drag it; and I do not know of anything more substantial than the pemmican we had, and I do not think there was anything of the weight of it which was so good.

8499. Do you think that a sledge party, provisioned as yours was, going over the same ground, would catch scurvy again?—Yes, I do. I think the sledge party that I travelled with was as good as any sledge party that could be picked out of the royal navy.

The witness withdrew.

Adjourned to to-morrow at 11 o'clock.

WEDNESDAY, 31ST JANUARY, 1877.

PRESENT:

ADMIRAL SIR JAMES HOPE, G.C.B., in the Chair.

ADMIRAL SIR R. COLLINSON, K.C.B.

VICE-ADMIRAL E. A. INGLEFIELD, C.B., F.R.S.

JAMES J. L. DONNET, ESQ., M.D., Inspector-General of Hospitals and Fleets, R.N.

THOMAS R. FRASER, ESQ., M.D., F.R.S.E.

H. J. VANSITTART NEALE, ESQ., Secretary.

WILLIAM MUNRO, ESQ., M.D., C.B., Surgeon-General, *examined.*

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M.D., C.B.,
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8509. (*The Chairman.*) You are Surgeon-General in the army, and head of the Medical Branch in the Department at Whitehall?—Yes.

8510. (*Dr. Fraser.*) What is your special department?—The Medical Branch, and the management of the executive of the Department.

8511. I think you have had some experience in India, have you not?—Yes.

8512. Have you had experience in the Crimea?—Yes; I may mention that I have also had experience at the Cape, in the West Indies, and in North America. The commencement of my service was at the Cape, then in North America, the West Indies and Bermuda, then the Crimea, and then India.

8513. Have you seen scurvy in connection with your service in any of these places, and in which?—Yes; at the Cape, in the Crimea, and in India.

8514. Had you occasion to study the conditions which produced the scurvy on any or all of these occasions?—I made no study of it, but I observed it.

8515. Can you give us an account of the scurvy which you saw at the Cape, in the first instance?—The scurvy there resulted from sameness of diet. It occurred amongst the troops, but in my own regiment to a very trifling extent.

8516. Where were they employed?—They were in the field during the Kaffir campaign of 1846, 1847, and 1848. The scurvy resulted from a sameness of diet, the diet consisting of fresh meat in abundance, and biscuits, but there was an entire absence of

8500. Do you think that there is anything that could be added to the provisions of the sledge parties to prevent scurvy?—Not that I know of; I could not think of anything.

8501. You have mentioned the salt meat being very salt?—It was.

8502. Do you think that the men had sufficient provisions to keep them in good health?—Yes, quite sufficient, and more than sufficient.

8503. And excepting this salt meat, you never heard a complaint against the rest of the provisions?—No; I have heard a certain complaint about the pork tasting a little fishy, although I for my part never noticed any fishy taste in it.

8504. Did you all like your lime juice?—Yes, all in the mess which I belonged to; every man drank it.

8505. Why did you drink it?—We drank it thinking it a preventive of scurvy, according to what we were informed by the medical officer on board: he ordered us strictly to drink our lime juice regularly.

8506. And you all drank it?—We all drank it.

8507. (*Admiral Sir R. Collinson.*) You made use of the phrase "limited provisions," I suppose by that you mean provisions of the same kind?—Provisions of the same kind.

8508. You do not refer to the quantity?—Not to the quantity; there was plenty in quantity.

vegetable diet. We had coffee, and a small quantity of rice. That was the dietary of the troops during the campaign.

8517. How did it happen that they had no fresh vegetables?—That part of the Cape is not prolific of vegetable productions. The farms are enormously extensive, and they did not cultivate vegetables, except for their own use.

8518. What part of the Cape was it?—It was on the Kaffir frontier between the Keiskhama and the Kei, from the Fish River up to Kei. In my own regiment, the 91st Highlanders, it was to a very trifling extent, we had very few cases. But then we were less exposed than the other regiments. We were less exposed during the campaign, we had less fighting, and we were more under cover and shelter than the others.

8519. Were you as destitute of fresh vegetable food?—No, because we were nearer the capital, Graham's Town.

8520. You yourself had fresh vegetable food?—Yes.

8521. What vegetables were they?—Speaking from memory, for it is thirty years ago, we had potatoes, pumpkins, and onions.

8522. Although it did not occur very largely amongst the men in your regiment, it did occur, you say, largely amongst the other troops?—Yes.

8523. Can you give us a notion as to what extent it prevailed?—I cannot, because I did not see it.

8524. But are you quite clear about the other

facts, which you have mentioned, as to the diet of these other men?—Yes, quite sure; the way in which our rations were issued to us was this: Live animals were driven alongside of us during the day, and were shot in the evening, and were cut up and given to us; and we carried our own biscuit.

8525. I believe it is not the custom to provide lime juice in your service?—No.

8526. Do you remember whether there were many fatal cases of scurvy?—I do not remember that; those few that I saw were not fatal and not severe.

8527. That was in your own regiment?—Yes.

8528. What treatment did you find beneficial in your own regiment?—The treatment that we used there, was the leaf of a tree called spekboom. It produced a leaf about the size of a shilling, and as thick as a shilling. It is very succulent, and it is extremely acid. The tree is always covered with leaves. What the particular acid of it is, I do not know, but I fancy it is malic acid chiefly.

8529. How did you discover that this was a valuable substance to use?—That I am not able to remember. I saw the surgeon of my regiment (I was assistant-surgeon in those days), prescribe it, and saw him use it.

8530. You do not know whether it is a recognised remedy among the natives, do you?—Not for scurvy, but they use it in ordinary life.

8531. How did you use it?—I merely stewed it with sugar.

8532. You had no lime juice?—Not that I remember.

8533. This was apparently an efficient substitute?—Yes; the few cases that I saw treated with it recovered.

8534. Did you in those few cases increase the quantity of fresh vegetables, which I understood you did have to some extent, or were you able to do that?—I cannot remember.

8535. You cannot remember whether you trusted solely to the spekboom?—No.

8536. Had you a larger experience of scurvy in the Crimea than at the Cape?—Yes.

8537. Can you give us an account of that experience?—I joined the army just as they were embarking at Baldchik Bay, and went across with it, and on joining my regiment (93rd Highlanders) the day we landed in the Crimea, I saw that they were all to a great extent below par. They had been in Bulgaria for some two or three months before that, and had suffered a good deal from cholera, and from the malarious fever of the country, and they were all more or less suffering from diarrhoea. I joined in September, 1854, when it was quite warm. All the time that they had been in camp in Bulgaria was warm weather. As I say, they were all suffering more or less from diarrhoea. We had no cover of any kind; we slept in the open air. Our rations at that time were salt meat and biscuits, no vegetables, coffee and a little sugar; that was at the beginning. We fought the battle of the Alma and went on to Balaklava. Diarrhoea was increasing amongst the men; but still we lived upon the same diet; we had no fresh meat and no bread; nothing but biscuit and no vegetable; and we got one ration of rum. This went on until the month of October. We had no cover of any kind all that time, but were living just in the open air, sleeping out at night, and no change of clothes or anything. About the end of October we got our tents, but the diet was still the same. About this time, a few cases of cholera appeared amongst us, and a good many of the men were sent away from the Crimea, suffering from diarrhoea. In December, I noticed that a number of the men had purpuric spots on their limbs. This went on with no change in the diet, and the men began to suffer very much from fever, and the diarrhoea then became more intense and more frequent, and had changed in its character completely. This particular phase of the bowel complaint I considered was scorbutic

dysentery, and I so called it in my report, part of which has been published in one of the books descriptive of the diseases in the Crimea. At this time the men began to show unmistakable signs of scurvy, and both scurvy and fever were killing them at the rate, during one month, of three a day. Amongst 900 men in the regiment (93rd Highlanders), there was one month, I think, when we lost three every night from fever, scorbutic dysentery, and scurvy.

8538. Then was there no lime juice sent to you?—No, we had no lime juice at that time. This was in December, 1854, and January, 1855. After that, we began to get a vegetable diet.

8539. Was that sent to you, or did you find it growing?—We found nothing growing; it was sent from this country.

8540. What was sent, do you remember?—I cannot recollect, but we had preserved vegetables in abundance, such as potatoes, cabbage, and carrots, and other vegetables, pressed.

8541. Did you derive benefit from this addition of vegetable to the diet?—Yes, the regiment from that day began to get into good health.

8542. Had you at the same time lime juice, or was that subsequent to getting the vegetables?—No, we had no lime juice then.

8543. I believe the scurvy was not at all limited to that one regiment?—No. It was difficult to treat those cases; there was such a complication. There was dysentery, and scurvy, and fever. It was distinctly continued typhus fever at first; then, as the men were beginning to recover health, the fever assumed a remittent type, but at the same time that the men were in this state, they were covered with scorbutic blotches on their limbs, and in one of those cases that died in this state, I made a post mortem examination, and I found that the mucus membrane and the internal surface of the large bowel were all marked, just like the men's limbs, with large purple blotches without any ulceration.

8544. Was there also an escape of the colouring matter of the blood?—Yes; I should say there was no ulceration, except in one case in which there had evidently been a large ulcer, and constriction of the bowel had taken place, but all round there was this sort of purple ecchymosis.

8545. The discolourations on the skin to which you refer, I suppose, were large?—Yes, at first they were very small, like flea bites, like typhus spots, then they extended all over the limbs.

8546. So that there were immense purple patches, I presume?—Yes.

8547. In the examination after death, did you find any discolourations elsewhere than in the mucus surface of the intestinal canal?—No, I did not examine any of the large organs. What induced me to make those examinations was the prevalence of this diarrhoea and dysentery.

8548. You have told us that the scorbutic symptoms were not by any means limited to your own regiment; were the causes in operation throughout the troops similar to, or the same as, those which you have already told us of?—Throughout the whole army it was the same, the absence of fresh vegetables.

8549. Did the scurvy occur among the troops of other nations besides ours?—I cannot tell you that; I can tell you that in the French army they died in hundreds the second year, from typhoid fever.

8550. That was in 1855, I think you have told us?—Yes, and 1856.

8551. Did the condition of your regiment become bad again at any time?—No, never.

8552. Did you always obtain a supply of fresh vegetables after that?—Yes.

8553. Did you have lime juice at any time?—I cannot remember that; I did not use it.

8554. You found the vegetables quite sufficient?—Yes, quite.

8555. Would you kindly give us an account of your experience in India?—I went out to India in

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1857 with the same regiment (the 93rd Highlanders). I was surgeon of the regiment, and, therefore, whatever I say with regard to the medical history of the regiment is authoritative, and is the best authority that can be given, I believe. We served through the Mutiny, from the relief of the Residency of Lucknow to the end. We were eighteen months altogether in the field, six months of which was hot weather. During all that time we were well fed with fresh meat and vegetables, and had our allowance of rum, and the regiment continued in perfect health, with the exception of a little exhaustion during the hot weather, and the results of the intense heat, heat-apoplexy; but the moment the cold weather came on we recovered perfect health and strength, that is during the second cold weather. At the end of the Mutiny we were sent to a hill station, and remained there six months. From that we marched 300 miles up the country to Rawal Pindi and remained there about twenty months. We then went to Peshawur, the most unhealthy valley in India. When we had been eight months in the Peshawur Valley, cholera broke out, and we had a terrible epidemic, which continued during three months in the regiment. This necessitated our going into camp in the end of September, and we remained in camp in the valley till the 10th of November, suffering very much from cholera, and from the Peshawur fever, and from intermittent fever. The Peshawur fever is a peculiar one, and is a link, I think, between the intermittent, the remittent, and cholera; in fact, a stranger would think it was a case of cholera. We crossed the Indus on the 10th of November, and commenced our march to Sealcote, a distance of 300 miles. We were two months on the march, during which the men picked up considerably. All this time, while we were in camp in the valley, and while we were marching, we received our regular full rations of bread, meat, and vegetables. The ration consisted of one pound of fresh meat; mutton was given once a week, and beef on the other six days; bread, one pound; vegetables, one pound, including eight ounces of potatoes, and the other eight ounces were made up of onions and any vegetables that were in the market; tea, five-sevenths of an ounce, or coffee, one ounce and five-sevenths, instead of tea; sugar, two and a half ounces; salt, two-thirds of an ounce; rice, as part of the vegetable diet, four ounces, and in lieu of rice two ounces of flour. When we could not get fresh vegetables, we got four ounces of what they called dhal, a sort of split pea, and four ounces of onions, and the troops had their regular allowance of rum, two glasses a day, all the time that we were in this camp, or if we were in quarters we got beer and a glass of rum.

8556. You never were without at least four ounces of fresh vegetables?—Never. Vegetables were always to be bought, for every regiment has its bazaar, which accompanies it on the march. The bazaar people go round the country and buy pumpkins, melons, oranges, lemons, and everything of that kind.

8557. Was the health of your men affected while under this diet, excepting as you have told us?—They were suffering terribly, as I have told you, from intermittent fever, but there was no taint of scurvy at that time (in the year 1862). We arrived at Sealcote in the very beginning of January, 1863. The men were all much better in health, but still suffering from intermittent fever, and they continued to suffer after they got into quarters very much from this form of fever. In the hot weather of 1863, about the month of July, I had three cases of most marked scurvy. I never saw a more marked case than one of them was. That man, during the whole time, had been receiving his regular fresh meat and his ration of fresh vegetable, and while in quarters had been getting his beer regularly every day.

8558. Was it the same with the other two?—Yes.

8559. Was this an extensive outbreak?—No, there were only three cases.

8560. Had those men suffered from the previous illnesses that were so general?—Yes, they had suffered a great deal from intermittent fever.

8561. To what extent would that affect their appetites?—My experience of ague is that you are able to eat.

8562. And you are quite certain that they ate their vegetables?—Yes, quite certain. I lived amongst the men, and knew everything they did, and said, and thought.

8563. Could you give the Committee an account of what symptoms you noticed in these cases?—The premonitory symptoms, langour, lassitude, and pains in the limbs, swelling of the gums, and discolouration of the gums; one man's gums were as black as this table, their teeth were loose, they bled from the nose and from the gums, and from the throat. They all recovered.

8564. How did you treat them?—I gave them lime juice, lemons, beer, and wine, and I was obliged to give them, at the same time, quinine, and fed them upon light nourishing diet.

8565. Do you remember whether their illness commenced at the time you refer to when your stock of potatoes ran short?—Our stock of potatoes did not run short; it was only under accidental circumstances now and then that we were short. I do not suppose there is any place in the world where the diet is kept up with so much regularity as in India. When we did not get potatoes the importation might fail, or something of that kind, but it was only for a day or two, or it might have been a week, but seldom or ever anything like so long as that.

8566. Were these always fresh potatoes?—Yes; fresh potatoes grown in the hills and in the district of Futteyghur.

8567. In your experience, were these three very exceptional cases so far as previous conditions of diet are concerned?—Yes, they were the first that I had seen in India at all. They were the only three cases out of the regiment, which at that time must have consisted of between 800 and 900 men. I was promoted out of my own regiment in 1867, and in the autumn of 1867, at the end of the hot season, there was a severe epidemic of cholera all over India. The troops in the Peshawur Valley were all put under canvas, and one battery of artillery, which I am going to tell you about now, the E Battery of the F Brigade of the Royal Horse Artillery, went into camp in the Peshawur Valley, and was greatly exposed to heat, and to malarious influence. In the cold weather of 1867, that is, probably, the end of November, or the beginning of December, this battery commenced its march for Umballah, and when it arrived in Umballah, about the end of February, 1868, the men of the battery were all scorbutic. So far as I could ascertain they had received their full ration all the time that they were in camp in the Peshawur Valley; and at the beginning of their march, the surgeon in charge noticed that they were getting scorbutic, and recommended a double ration of vegetables, which they got, consisting of potatoes and onions.

8568. Would the double ration be 16 ounces?—I cannot tell to an ounce. They were all scorbutic when they arrived in Umballah in 1868, and they gradually recovered under the ordinary ration with their beer and rum. From these two facts which I have mentioned, one with regard to my own regiment, and the other with regard to this battery, I believe that scurvy appeared amongst them, and was attributable to debility from exposure to the intense heat and malarious influence, even although they had their full ration of vegetables.

8569. Did lime juice enter into the treatment of the cases in the battery?—No, not in the battery;

but in my own regiment it did. I do not know what the treatment of the battery was; the men were not so bad as to require to be admitted to hospital for their scorbutic taint, but some of them were so unmistakably bad that their teeth were loose.

8570. In the three cases in your own regiment, did the lime juice appear to do much good?—I did not trust to that; I gave them beer and wine, and all kinds of vegetable diet, and the best food I could give them.

8571. So that you are not able to separate exactly the influence of the lime juice from that of the other articles?—No; but if you want my opinion, I do not think that lime juice would have cured those men without the other adjuncts.

8572. This, I suppose, is your whole experience of scurvy in India?—Yes, my whole experience.

8573. I gather that you consider that in India scurvy may occasionally occur amongst men who have been subjected to the injurious influences of malaria, fatigue, and exposure, whatever the dietary may be?—Yes.

8574. Do you think that scurvy would occur more rapidly with a dietary of a defective kind?—Yes, because then the debilitating influences would be worse.

8575. Would it occur most rapidly if the dietary were defective in the direction of fresh vegetable food?—Yes, I think so.

8576. These somewhat exceptional cases, so far as the records of the outbreaks of scurvy are concerned, do not alter your opinion, do they, that the main cause of scurvy is, as I have already stated, the absence of fresh vegetable food?—I am not prepared to say that I think so. I say that that will be the main influence; but I mean to say that I believe, with the best vegetable diet, exposure to prolonged fatigue and malarious influence will produce scurvy in spite of the very best vegetable diet.

8577. Do you think more rapidly if the best or any vegetable diet is absent?—Yes, certainly.

8578. Or defective in quantity?—Yes, certainly.

8579. Your experience at the Cape and in the Crimea seems to show that one of the main causes of scurvy was the absence of fresh vegetables?—Yes.

8580. And in that manner contrasts with your experience in India?—Yes; but it must not be forgotten what we underwent in the Crimea, the exposure, fatigue, and the starvation in every way. I have known men in my regiment pass days and days without eating a morsel of animal food.

8581. Generally speaking, is it your opinion that scurvy is a disease of nutrition?—Yes, and of exhaustion.

8582. Have you in any of your experiences been in a position in which you could form an opinion with regard to the antiscorbutic value of lime juice?—No.

8583. Your cases were generally complicated?—Yes, very complicated; I have never seen a case of uncomplicated scurvy.

8584. Do you know that scurvy often occurs in India in the conditions which you have told us about?—Those are the only two instances that I ever heard of while I was in India, those in my own regiment and those in this battery; they were the only ones that came within my own knowledge.

8585. It has occurred, however, in India frequently, has it not?—Yes, it has; but I am not prepared to give you any information except what I know myself.

8586. I need not ask you, in that case, if you know if scurvy has occurred among the natives, or if you have seen it among them?—No, I have never seen it amongst the natives; but I have seen that dreadful elephantiasis in a great number of cases, those enormously swollen limbs, which I believe are the result of starvation and imperfect food.

8587. (*Dr. Donnet.*) Was the diarrhoea observed

amongst the troops in the Crimea in 1854 and 1855 simply the first symptom of cholera, or was it an incipient symptom of scurvy?—It was so universal that I believe it was an incipient symptom and sign of scurvy.

8588. Did the symptoms in the cases mentioned depend upon scurvy alone, or upon dysentery and typhus combined?—They were all complicated cases; there was dysentery, and scurvy, and fever.

8589. Were these cases an instance of diseases running a parallel course in one and the same person at the same time?—I think so; you may have dysentery and you may have malarious fever, and you may have ague very badly, at the same time.

8590. This instance of diseases running a parallel course in one and the same person is, therefore, a refutation of John Hunter's theory, which is embodied in the following words:—"It appears to me, beyond a doubt, that no two actions can take place in the same constitution, or in the same part, at one and the same time. No two different fevers can exist in the same constitution, nor two local diseases in the same part, at the same time"—Yes. John Hunter was not in India or in tropical climates.

8591. I think you said that men may become subject to scurvy, although provided with vegetables?—Yes, I think so.

8592. During the Crimean campaign, the French troops suffered very much from scurvy; do you know the nature of the diet which was supplied them?—No, I do not know any of the history of the French army, so far as their sickness and mortality were concerned.

8593. Do you know that when labouring under scurvy, they succeeded in getting a large quantity of dandelion, and that they became better under its influence?—Yes, I know that, but I cannot speak of it from my own personal experience. I have often seen the Russians themselves, after the war was over, gathering herbs to make soup of them, and I have seen the French doing it too.

8594. Do you know whether the Russians suffered from scurvy?—I do not know.

8595. In the sea voyages that you have been obliged to take from England to the Cape and the East Indies in medical charge of troops, have you observed any symptoms of scurvy?—No, never.

8596. Were the ships well provided with vegetables, or was a ration of lime juice given?—A ration of lime juice was given, I forget how many days after we started, but it was always given. The only case that I know of, and I do not know that from my own experience, was that, in the 55th Regiment, when they were going out to India, they had one bad case of scurvy, and yet that man had taken his lime juice regularly during the voyage.

8597. Did you know the character of the man?—No; I only tell you this from one of the sergeants who was on board, and who is now an officer. He told me of this case, and I have endeavoured to trace it in some return, but I have not been able to do so.

8598. I think you said that cold, fatigue, and impure air would of themselves debilitate the body?—Yes, no matter how you feed the men.

8599. And you think that those influences will assist in producing the disease?—Yes, most undoubtedly.

8600. Will they produce scurvy?—I think so.

8601. Will they produce scurvy without the absence of fresh vegetable food?—Yes, I think so; I think that those cases that I gave you of my own regiment and that battery show that.

8602. Can you inform the Committee of any prominent instance which would give additional weight to this assertion?—Those three cases which I mentioned in my own regiment, and those in the battery of artillery. My own regiment, as I tell you, was nearly two months in the Peshawar Valley under canvas, suffering severely from an epidemic attack of cholera, and from intermittent fever, and yet they

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were fed all the time on the full ration of meat and bread and fresh vegetables.

8603. Was this battery similarly situated, and fed on their full ration?—Yes.

8604. Had you many cases of scurvy in men regularly supplied with fresh vegetables?—Only the three that I give you in my own regiment, but the whole of the battery that I mentioned were more or less scorbutic.

8605. Can you say what vegetables they were able to get?—Potatoes and onions. In every bazaar you can get pumpkins, or buy oranges and limes the whole way through India.

8606. Do you think that a very great degree of cold and fatigue will produce scurvy?—Yes, I think so, even if the men are well fed.

8607. Do you think that the great degree of cold and fatigue to which the late expedition was subjected, would of themselves produce scurvy?—I think so.

8608. Have you had experience of yellow fever in the West Indies?—Yes, I have seen it in Bermuda.

8609. Have you been able to ascertain whether the conditions which assist in developing yellow fever are not in greater force one year than they are in another?—I have only been through one epidemic, and I was sent down straight from North America, into the middle of this epidemic, in 1853, therefore I cannot tell you anything from my experience as to the periodicity of its appearance. I know that they say that it appears every 10 years, in Bermuda and I know that they say it always comes in the month of August, but I cannot tell you that from my own knowledge.

8610. Have you formed any opinion on this question, and can you account for the immunity of one year over another?—No; in Bermuda the people say that it always comes in the month of August, and during the prevalence of a certain wind, which blows up from the south-west, which they say is a damp, depressing, and debilitating wind, accompanied by a foggy state of the atmosphere.

8611. Your impression is that cold and fatigue will, of themselves, produce scurvy?—Yes, I think so.

8612. But simply, I imagine, as predisposing causes in the absence of an exciting cause?—I think they would be predisposing causes, and that they might be the exciting cause too. They depress the vital energy to such an extent that they will both predispose and induce.

8613. I believe it is the general opinion of the medical profession that scurvy only occurs where fresh vegetable nutriment has been for some time partially or completely withheld; is that your opinion?—No, it is not my opinion, and I have given you instances, I think, that you may have it in spite of the regular proportion of vegetable diet; that it is not a certain preventative.

8614. What value do you attach to the issue of lime juice in the naval service?—I cannot tell anything about the naval service. It was in consequence of the former prevalence of scurvy that lime juice has been given, and now is a regular ration in the Navy.

8615. (*Admiral Inglefield.*) I think you have informed the Committee that you are aware that lime juice is given as an antiscorbutic?—Yes.

8616. The drawback that was found in administering it on the sledging journeys was that it could not be carried with a sufficient quantity of material for thawing it, and also for thawing water for mixing with it; do you conceive that lime juice could be concentrated into such a form that it might be carried as a lozenge?—That is a chemical question which I cannot answer, but I think that the lime juice might have been carried and given even in its frozen state. A man would suck a piece of frozen lime juice just as he would a piece of ice.

8617. The Committee have had some lozenges pre-

pared by Bell and Company, of Oxford Street, who profess that there is an ounce of lime juice concentrated in four of those lozenges; would you mind tasting one and telling me whether you think it is so (*handing the same to the witness*)?—That is a chemical question, it is pleasant enough and it resembles lime juice.

8618. If by analysis we find that the parts that are supposed to be antiscorbutic are not destroyed, would not that be a very appropriate form for using it either in the field or in sledging?—I think so, certainly.

8619. But the thing has never been suggested to you in that form?—No.

8620. Have you made any remark as to the age of men, whether they are more susceptible to scurvy at one age than another?—No.

8621. I think you told the Committee that you have never seen the natives attacked with scurvy?—Never.

8622. But they used this particular leaf, you say, which you called spekboom, at the Cape; for what purpose did they use the leaf; merely as a food, or what?—I have never seen the natives use it, it is the European portion of the community that use it.

8623. They use it, do they not, as we would gooseberries?—Yes, to make tarts.

8624. Does it grow upon a tree, or is it a shrub?—It grows upon a tree.

8625. Have you any idea whether it has been tried in England?—No, I never heard of it. It is one of the most abundant trees in the forests and jungle at the Cape; it is a tree upon which elephants feed very largely.

8626. Had you an opportunity of trying the leaf of that tree in conjunction with lime juice?—No, by itself.

8627. And were its effects as rapid and as effective as lime juice?—Yes, to the best of my recollection.

8628. Does it retain its properties after being cooked, do you think?—It retains its acidity.

8629. In your case you used a green leaf?—Yes, about the size of a shilling, and as thick as a shilling, or perhaps a little thicker than a shilling.

8630. You, perhaps, may not have it within your power to obtain a specimen of those leaves for the Committee?—No, but I will endeavour to get the botanical name.

8631. You never saw it growing anywhere but at the Cape?—Never.

8632. You have seen scurvy in India, at the Cape, and during the Crimean war; was there any difference in the scorbutic symptoms exhibited in those different climates?—No, no difference; there were different complications, but the scorbutic symptoms were the same.

8633. (*Dr. Fraser.*) I think you told us that the three cases that occurred in your regiment were subsequent to other diseases?—Yes, not only subsequent, but while the other diseases existed.

8634. Those diseases being what?—Intermittent fever.

8635. Even although the appetite was good during intermittent fever, do you think that all the food that was swallowed would be digested and assimilated in the same way as in a person who was not suffering from intermittent fever?—No.

8636. And, therefore, although vegetable food may in those circumstances be swallowed, so far as you are aware, would the vegetable food have served the usual function of vegetable food in the system?—It is quite possible, but there was nothing apparent to make me think so.

8637. Your experience, however, I think, was limited to three cases?—Yes, on that occasion.

8638. In reference to the outbreak in the E Battery, F Brigade, Royal Horse Artillery, what was the general illness previously to the occurrence of the scorbutic taint?—Intermittent fever also.

8639. Was it while the men were suffering from

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intermittent fever in this instance likewise that the scorbutic taint occurred?—Yes.

8640. Then I suppose if it be the case that the food swallowed might not have been assimilated in the same way as in healthy men in the three cases that occurred in your regiment, the same might have been the case with the men in this battery?—No doubt.

8641. Did these three cases alter in the least degree your opinion that scurvy is a disease of mal-nutrition?—No, I do not think so. The men's appearance in all those cases in the battery, and in my own regiment, would give you no idea that they were suffering from want of nutrition.

8642. They do not, therefore, alter your opinion?—No.

8643. Can you tell me if while those cases occurred the temperature was high, or about what was the temperature?—The temperature was high in my own cases, and in those of the E Battery the temperature was low. It was during the cold weather.

8644. What was about the degree of cold?—About 40°.

8645. What we should term temperate here?—Yes, but we should feel it cold; and the higher temperature would probably average about 84° or 86°; 40° in India would be considerably below freezing at home so far as our sensations were concerned.

8646. Besides this illness from intermittent fever, what other conditions probably reducing the standard of health were in existence in the cases in your regiment and in the E Battery?—Both of them had been before this for months exposed to prolonged heat. The heat in the Peshawur Valley, in the months of July, August, and September is most oppressive; it is a damp, close, muggy heat, and both the regiments had been exposed to this for several months. Then cholera broke out, and they had to go into a cholera camp, where they were still exposed to this debilitating influence of heat. Then from that time during the march the weather was extremely cold to our feeling.

8647. Do I understand the history of the case of the E Battery to have been that the men had first suffered from cholera, and that then malarious intermittent fever supervened, and that during the occurrence of that malarious intermittent fever scorbutic symptoms occurred?—Yes.

8648. May I ask you again what your evidence is; what are the reasons exactly upon which you feel satisfied that the men in the E Battery had, at the time of the supervention of the scorbutic symptoms, been taking their full allowance of vegetables?—The matter was referred to me, as the principal medical officer of the division, whether that extra vegetable diet should be paid for or not.

8649. I understand you, however, to say that this extra vegetable diet was ordered only after the occurrence of the scorbutic symptoms?—Yes.

8650. Previously, how do you know that the vegetables were really being eaten by the men?—I cannot say in that case.

8651. Then you do not know?—No, no further than that it was issued for them.

8652. There was a ration of potatoes, but you are not aware whether it was consumed?—Not in that case; but in the case of my own regiment I am aware that it was consumed.

8653. Had the three men in your own regiment been suffering from anything previously to this intermittent fever?—Nothing.

8654. Were they being treated for intermittent fever at the time?—They were not in the hospital.

8655. How were they being treated?—At that time we used to give them a regular daily allowance of quinine. After the appearance of cholera every man in the regiment got a small dose of quinine, and that was continued for two months; so that the expenditure of quinine was considerable in that individual regiment.

8656. Then the history of your regiment, as I understand, is that there was first an outbreak of cholera?—Yes.

8657. And at the end of that outbreak quinine was administered?—At the end of that outbreak intermittent fever became prevalent throughout the whole regiment, and from that time I gave them a daily dose of quinine; the whole regiment used to parade and get this dose of quinine.

8658. And then, out of between 800 and 900 men, three of those men who were then suffering from intermittent fever had symptoms which appeared to be those of scurvy?—Yes, what is called real scurvy; not symptoms which appeared to be scorbutic, but what I call scurvy.

8659. May I again ask you exactly your grounds for stating that those three men were really consuming their rations of fresh vegetables?—As I told you before, I lived with the men of my regiment, and knew everything about them; how they ate and how they drank, and everything.

8660. What evidence have you of these three men having consumed their rations?—In the history of their case I enquired if their regular ration was eaten, and I found that it was.

8661. Is it within your experience that during intermittent fever the men always ate their full allowances?—I have seen men suffering from intermittent fever, that you could not possibly tell there was anything the matter with them; they were looking as healthy and as strong as we do; that shows that they were eating their rations; and I have seen a man who had a fit of ague get up and go to his work as if nothing had happened. If that were not so, we would in India sometimes have whole regiments perfectly unfit for anything.

8662. Then you made enquiries after the scorbutic symptoms occurred in these three cases?—Yes.

8663. As a result of those enquiries, you felt satisfied that the full rations had been consumed?—Perfectly.

8664. May I ask you further whom you enquired of?—Of themselves.

8665. You have also told us about a case in the 55th Regiment?—That is only from hearsay.

8666. That case did not come under your personal observation?—No.

8667. And you had no opportunity of making any careful enquiries?—None whatever. This was on board ship, and it was only from one who was on board ship that I heard it.

8668. How many years afterwards did you hear it?—Only lately.

8669. Can you give me some idea of how many years afterwards?—It must have been seven or eight years.

8670. And it was not from a medical gentleman that you heard it?—No.

8671. It was mere conversation?—Mere conversation.

8672. Were there no opportunities of substantiating the facts?—None whatever.

8673. Then you do not place a great deal of reliance, do you, on this case?—No.

8674. I have also understood you to say that fatigue and exposure, without any errors of diet, may produce scurvy?—Yes.

8675. You, of course, are perfectly aware that that opinion is contrary to almost all experience?—I am.

8676. You are also quite aware, I think, that nearly every observer and enquirer, from the most careful examination of the history of scurvy, and of outbreaks of scurvy, has arrived at the conclusion that the only necessary antecedent of scurvy is an absence or defect in the quantity of fresh vegetable food?—Yes.

8677. Your opinion is derived from these experiences in India, of which you have given us the particulars?—Yes.

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8678. And your other experiences at the Cape and in the Crimea are quite in accordance with the accepted views, are they not?—Yes, but at the Cape, though food was abundant, it was too much of one kind, while in the Crimea there was absolute want of food, added to great exposure and fatigue.

8679. May I ask you what you exactly mean by exposure as a necessary antecedent?—Want of clothing, want of covering, sleeping on the ground, exposure to great alternations of heat and temperature, and of moisture, and bodily fatigue; I call that exposure.

8680. Do you include a low temperature?—Yes, alternations of temperature, at one moment hot and at another moment cold, or continuous heat; I have not much knowledge of continuous cold; I have had no opportunity of coming to a conclusion.

8681. Granting that fatigue and exposure may of themselves produce scurvy, do you think that fatigue and exposure in conjunction with such a defective dietary as does not contain a sufficient amount of the vegetable element will produce scurvy more rapidly than fatigue and exposure alone?—Yes.

8682. I have no doubt that you are aware that since lime juice has been given compulsorily as a substitute for fresh vegetables, the number of cases of scurvy has decreased in a most remarkable manner?—Yes, but how far is that conjoined with better food, care and accommodation? In former days in the merchant service and navy the dietary was not so good as it is now, it was more constituted of salt provisions, and less of vegetable. Ships were smaller, often crowded, and ill-ventilated; passages were longer and work harder than in the present day.

8683. Then do I understand you to say that there being also changes in diet, you yourself are unable to arrive at any opinion as to the effect of the lime juice?—You ask me first if I am aware that since the introduction of lime juice into the naval service and merchant service, scurvy has greatly diminished, and I say in reply to that, how far has that been influenced by a general improvement in the food?

8684. There has been a diminution of scurvy, has there not?—There has.

8685. Can you give us any opinion as to what effect on that diminution the issue of lime juice has had?—No, I cannot give any medical opinion as to the extent.

8686. Can you give us any opinion as to any effect that lime juice has had in the diminution?—Supposing that the same dietary of salt meat and absence of all vegetable diet had continued, and that the same conditions described above still existed, the question is would the lime juice of itself have been sufficient to

have produced the results that have been produced?

8687. I will ask you the question in this form: has the lime juice, in conjunction with other improvements, been beneficial?—Yes, I think so, certainly.

8688. It has had some share in the result?—Yes.

8689. Do you think that lime juice is valuable in scurvy?—Undoubtedly.

8690. Do you think it is judicious, in the absence of sufficient fresh vegetable food, to subject men for a considerable period of time to a diet in which there is no lime juice?—I think I have answered that question already. I think it would not be judicious.

8691. Then do you think that there should be a considerable proportion, or some proportion, of fresh vegetable food or of lime juice in every diet list?—Certainly.

8692. Have you formed any opinion as to the proportion of fresh vegetable food there should be?—No, but I know the proportions laid down as necessary.

8693. If I were to ask you if two ounces of potato was sufficient in a dietary to represent the vegetable part of a dietary, do you think it sufficient?—No.

8694. Do you think that, in such a dietary, it would be judicious to withhold lime juice?—No, certainly not; you must have your fair proportion of vegetable diet.

8695. And your opinion is decided that two ounces of preserved potato is not sufficient?—Yes, that it is not sufficient.

8696. (*Admiral Inglefield.*) Is it not the case that the men always liked vegetables, and that there is every reason to suppose that vegetables were eaten by the men whenever they could obtain them?—No doubt.

8697. In no case, either in India or the Crimea, did the men, whenever they could obtain vegetables, not eat them almost greedily?—Yes, and the men used to go into the bazaars and buy fruit, in addition to their vegetable diet.

8698. (*The Chairman.*) In the three exceptional cases of scurvy which occurred under your own supervision in India, your attention, I presume, was very specially drawn to all the conditions by which they were accompanied?—Yes.

8699. We have been told by one of the medical gentlemen who have been before us, that however satisfactory the chemical analysis of the lozenges which you have seen, or any other preparation of a similar description might be, he would not trust them until they had been tried on a considerable number of men for a lengthened period? Do you concur in that opinion?—Quite.

The witness withdrew.

JOHN RAE, ESQ., M.D., F.R.G.S., *examined.*

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8700. (*The Chairman.*) You are a Licentiate of the Royal College of Surgeons, an LL.D. of Edinburgh, and a Fellow of the Royal Geographical Society, and were formerly a surgeon in the employ of the Hudson's Bay Company?—Yes.

8701. Enumerate the Arctic expeditions in which you were engaged in the service of the Government?—In 1848-9 with Sir John Richardson at Great Bear Lake, and from the Mackenzie to the Coppermine River; and in 1850-51 also by way of the Great Bear Lake. Those were searching expeditions for the lost Franklin expedition.

8702. During those expeditions, had you much experience of sledge travelling?—In the spring of 1851 I was 47 days sledge travelling along the coast and down the Coppermine River. I travelled on that journey 1,080 miles at the rate of 23 English miles a-day. The sledge party consisted of myself, two

men, and four or five dogs. The dogs were of very little use, being weak from previous hard work. My principal experience of sledge travelling was on two expeditions on which I was employed by the Hudson's Bay Company alone.

8703. (*Admiral Sir R. Collinson.*) I believe you accompanied Sir John Richardson in the year 1849 down to the Arctic Ocean?—1848.

8704. Will you just be good enough to describe what you did on that occasion?—Boats were taken out from England to York Factory, and Sir John Richardson and I overtook these boats on their way to the Mackenzie at Portage La Loche. We afterwards embarked the men in these boats—all sappers and miners, and sailors, brought out from England; I think 15 sappers and miners, and 5 sailors.* We descended the Mackenzie to the coast, then went eastward until we arrived at some few

* All the sailors, with 12 of the sappers and miners, and Albert the Eskimo interpreter, formed the crews of the three boats to the coast.

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days' journey from the mouth of the Coppermine, where we were stopped by the ice. The whole coast was searched very closely; depôts of provisions were left at different points, but there were no traces of Sir John Franklin's party seen, and nothing heard of them from the Esquimaux. The ice stopped us at the point I have mentioned.

8705. Was it near Cape Krusenstern?—Near that, but farther on, beyond Cape Hearne.

8706. After landing there, where did you winter?—We abandoned our boats at this point; they were cut through by the new ice, and we travelled overland to Fort Confidence on the Great Bear Lake, where Sir John and some of his party wintered.

8707. Did you winter with them?—Yes.

8708. Your crew, as far as your statement has gone, consisted almost entirely of Europeans?—Yes, I speak from memory; 12 sappers and miners and 5 sailors, and the Eskimo Albert.

8709. Will you tell the Committee how you passed the winter, and what food those Europeans were fed on?—The most of the Europeans (13) were sent off to the Great Slave Lake to winter there. There, their food would be almost entirely white fish, a favourite fish that we feed a large part of the district of the Mackenzie River upon in the winter; most of the men on the lower river are fed on this fish.

8710. Had they any farinaceous food served out to them?—I find there were about 25 lbs. flour or barley meal served out to each man during the winter—240 days. I looked up Mr. Bell's ration-book in the winter of 1848-9, and these are the daily rations: eight pounds fresh venison per man; four pounds each woman; two pounds each child; or four pounds half-dried meat for a man, two pounds for a woman, and one for a child; or, when we had fish, three large white fish per man, two large white fish per woman, and one per child. These fish ranged, according to my memory, from three to four pounds, each weighed, as taken out of the water.

8711. What did the men get in the way of tea or cocoa?—As far as I can remember, nothing, or very little, an extremely small allowance. Our own allowance, Sir John Richardson's and mine, was extremely small. I can give you the details. (Appendix 27.)

8712. We want rather to see the bearing of the diet upon the people. I wish you at the present moment to give the Committee the information that you have with respect to the diet, during the winter, of the men?—This is exactly the diet that I have given; the diet as I find it issued; there was an issue of flour on Christmas Day; 96 lbs. to all the people at the Fort.

8713. Had they no biscuit?—No biscuit.

8714. No spirits?—No spirits.

8715. No tea?—Very little, if any; it is not issued as a ration. In the Hudson's Bay service, tea was then never issued to the men; they got tea and sugar to purchase, but even a very limited quantity of that, it being so far to carry it.

8716. Then am I to understand you that during this period of eight months, the men that were attached to you, who were Europeans, were feeding on a carnivorous diet, without farinaceous or vegetable food?—Almost entirely. The whole of the flour, as a rule, was kept for the voyaging. I must so far qualify this reply, for I find at fol. 77, vol. II. of Sir John Richardson's narrative, that 6 cwt. barley meal, and 2 cwt. rough barley were brought to Fort Confidence by Mr. Bell, of the distribution of which I can find no account. This, if divided among the people who wintered at Fort Confidence and those who went to Slave Lake, would give to each about 25 lbs. or at the rate of $\frac{1}{10}$ lb. a-day for eight months.

8717. Now, after this carnivorous diet, what was the condition of your men in the ensuing spring?—Perfectly well, perfectly sound and healthy.

8718. Will you shortly describe to the Committee what work they went through the following year, so

that the Committee may have an idea of the labour?—The following year I do not know what work the Europeans went through; they were quite away from me. I only saw the work they did when they went down the Mackenzie along the coast, until their arrival at Fort Confidence; that was the only time that they were under my supervision.

8719. But when you descended to the coast the following year, did you take any of them with you?—None; people of the country in 1849.

8720. Then they returned to Europe with Sir John Richardson?—They returned to Europe by the ship from York Factory, in 1849.

8721. But when they parted with you, so far as your knowledge goes, you think the men were in a good state of health?—Perfectly good; they were a little footsore from the 13 days' march, which was a very heavy one, but there was not the slightest sign of any disease that either Sir John or I could see.

8722. Will you detail your experience in previous explorations?—In 1845, (*pointing it out on the map*), a large extent of the arctic coast was known to be unsurveyed—600 or 700 miles—between Sir Edward Parry's farthest at the Straits of Fury and Hecla, and Sir John Ross's surveys on the east coast of Boothia. Three Government expeditions had failed to do this work, Sir Edward Parry's with two ships, Captain Lyons in the "Griper," in 1825 or 1826, Sir George Back in the "Terror," in 1835, both of whom attempted to reach Repulse Bay, but failed. The Hudson's Bay Company proposed that I should endeavour to do the survey. Finding that ships had failed, I took small open boats, went 900 miles along the coast of Hudson's Bay to Repulse Bay. Not being able to get the boats, in consequence of ice, along the shores to be surveyed, I determined on wintering. I had with me 10 men and 2 Esquimaux. We built a stone house; we collected enough andromeda to cook once or twice a day; killed reindeer which fed us during the winter; made winter dresses and bedding of the skins; never warmed ourselves at a fire the whole winter, because our fuel gave so little heat that the smoke would not go up the chimney; consequently we had to open the door when cooking however cold the weather, so we lost heat instead of gaining any. We started in the spring with sledges and surveyed the coast up to Sir James Ross's furthest point on Boothia, at Lord Mayor's Bay; then returned, having been absent 31 days, and travelled at the rate of more than 22 miles a day. The provisions consumed were at the rate of one and a third pounds of pemmican, and a third of a pound of flour a day. Part of this pemmican had been given to some dogs we had, but to make up for this loss, we obtained sufficient seals' flesh and fat from the Esquimaux for seven or eight days. This seals' meat is extremely tasteless, and as we had not taken any salt with us, which I never carried on these expeditions, when we cooked it we generally added a little salt seawater. The only unpleasant effect was the producing extreme constipation, all of us, four in number, Europeans, suffered extremely from constipation, from which the two Esquimaux were exempt; probably because they used more of the blubber than we did. On returning to Repulse Bay, I started with another party, one man being the same, and surveyed the west coast of Melville Peninsula, very near to the Straits of Fury and Hecla. The labour on this journey was excessive; the ice and coast were so rough that no sledges could be hauled, so we had to carry everything on our backs, and had in many cases to follow every indentation, of the coast. This journey occupied us 28 days, and our consumption of food was $1\frac{1}{2}$ lbs. of pemmican per man and a quarter of a pound of flour per man, with a small allowance of tea, chocolate, and sugar. We shot one deer, several hares, and a few ptarmigan. The total distance of these two journeys amounted to something

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over 1,200 miles in 59 days. My men were perfectly healthy the whole time. They had no spirits except a glass or two of brandy at Christmas and New Year. We neither had spirits during the winter nor on the sledge journeys. In all these journeys we built snow houses every night, and the consequence was that our bedding for five persons amounted only to 25 lbs. weight, consisting of single blankets to place over us, and a thin strip of reindeer skin with the hair on to place between us and the snow. I may add that throughout the whole time we never slept cold but once, when my snow builder made, by accident, the snow house too short, and we were obliged to shove our legs outside. I may further add that we never missed having snow enough either in a good condition or a bad condition to build a snow house. We never failed to build a snow house. We got away from Repulse Bay in August, and reached York Factory in safety, not a soul having been injured in any way, and, indeed, we were in much better condition when we got back than when we left York Factory; all the men that I had with me, as well as myself, had either been born in the country, or had passed many years in the Hudson's Bay service, never having had any regular rations of grog served out to them.

8723. Was that allowance of pemmican and flour sufficient for them to subsist upon?—We made it do, but we were very hungry. It was my first expedition, and I thought that we would have got more game to kill, but I was disappointed, and we starved a little. I may mention, to show that this was so, the few ptarmigan that we shot were divided, and we used to eat the bones up to the beak, and to the claws on the feet. I, as a sportsman, used to keep the head as a perquisite for myself over and above the division with the others; on that journey we were, however, perfectly healthy the whole time, but became very thin.

8724. And the total number of days' absence was a year and two months?—A year and nearly three months on that occasion.

8725. After having performed this extraordinary journey you remained, did you not, in the Hudson's Bay Company's territory in charge of a post?—I returned in 1847 to England, and then Sir John Richardson asked me to join him in the spring of 1848.

8726. We will now proceed to what you did after Sir John Richardson left you; will you describe the men whom you had with you, because it is of importance to our inquiry that we should know whether they were Europeans, or whether they were half-castes or Indians?—I can give you a list of the nationalities of all the men that I had on the expeditions on which I was employed. On the occasion of which I have spoken, three or four of the men were from the Orkney Islands, two or three were Canadians, one was a pure Indian, and the remainder were what we call half-breeds, that is, a cross between a white man and an Indian; they were admirable travellers, not especially selected for sledge travelling, but some of them as fishermen, and others as hunters, and for general service.

8727. Where did you start from on this occasion in the spring, after Sir John Richardson left you?—In the year 1850, I was asked by the Government to proceed to the coast, but I could not go then as we had neither provisions nor the means of travelling in the Mackenzie. Sir George Simpson sent me a party of 12 men from the Red River, who were a mixture of half-breeds and French Canadians, and some Europeans. We wintered at the old place, Fort Confidence. I could not descend the Mackenzie, as was expected, because Captain Pullen took up that line of search, and the fitting out his expedition took all the available provisions that were at Fort Simpson; therefore, I had no possible way by which I could reach the coast, except by going to Fort Confidence. I had no

boats prepared of the proper size to haul over land, so we wintered at Fort Confidence, and I draughted a boat myself, and, having a very good carpenter, we built two boats, a thing never previously attempted. The wood was very inferior, being fresh cut boards. Mr. Thomas Simpson, who wintered twice at this place, said it was quite impossible to build a boat there. I had no sailors with me, so I cut out the sails and roped them, and rigged the boats with my own hands, with no person to assist me. In the spring, with two men, for I could spare no more, I started off and made a journey, which is marked on one of the maps shown, along the coast of Wollaston Land, accompanied by the two men and four dogs, in very poor condition, one of which afterwards became useless.

8728. Will you describe your sledges?—My sledges were exactly like the one that I have here sketched, what we call an Indian sledge (*producing a sketch and explaining it to the Committee*). The advantage of this sledge is that it runs equally well over the hard snow, or the hard ice, as the Government sledge, but when it comes to deep snow it cannot sink more than three-quarters of an inch. My attention was particularly called to that by the remark, I think, of Captain Aldrich, in one of his answers to a question put to him, in which he stated that in the soft snow that they had to go through frequently, there was a large roll of snow formed, pushed up by the canvas bottom of the sledge, and this large roll of snow was carried before the sledge, and the men had to drag the sledge through it, which must have given them an immense amount of labour. I allude to that especially, as I am told that this is a true representation of some of the positions of the sledges on the late expedition (*producing a drawing and explaining it to the Committee*). My sledge could not stick in that way, and some of the gentlemen who came back told me that it was like tearing their arms out to get the sledge out of that position. The sledge that I show you would have run down and come up half the opposite slope, perhaps. I have done it over and over again, and it cannot sink deep.

8729. Had you one of those sledges or two?—We had three sledges. I hauled one myself, and the only difference between the sledge shown in the sketch and mine was that mine were made for one man only, and could carry about three hundred pounds, if we liked to put that weight on, but they had not a middle runner. This sledge being for four men, and very broad, requires a third runner to prevent the thin boards being pressed down by the weight. I should say that in 1847 I used the high runner sledge because I had not had previous experience of arctic work. This sledge, although on high runners, had an advantage over the Government sledges, because we iced the runners after the Esquimaux fashion, which makes the sledge run so much more easily, that a man can haul very nearly double the weight than he can on a sledge not so prepared.

8730. What was the distance from your winter quarters to the coast, and how many days were you doing it?—Seven days from the Bear Lake to the coast, and the distance about 150 miles.

8731. And you dragged three sleighs, which at starting were 300 lbs. weight?—We had much more than that altogether. I could not tell what our sledges weighed; we are in the habit of speaking, not of the weight of the sledge, but of what is on the sledge. It is the habit of the country to say that a man has hauled so much; that does not include the weight of the sledge. When we load them for a dog, we give him 100 lbs., and the man's load is perhaps 150 lbs., when he is going any distance hauling one of those flat sledges; but I have known an Indian woman haul into the Fort upwards of 200 lbs. of meat, and the weight of the sledge was extra, she having hauled it through the snow with snow shoes

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on, at the rate of 10 or 12 miles a-day, perhaps more.

8732. Then you crossed over to Wollaston Land, and returned to the continent, after how many days, to your winter quarters?—We did not return to our winter quarters. In the spring sledge journey, we returned to the Kendal River, having been 47 days absent from Fort Confidence, having travelled 1,080 miles at the rate of 26 miles a-day for the 42 days we *could* travel.

8733. Where you directed the boats to meet you?—Yes, where I directed the boats to meet me, and where they arrived a few days after my return.

8734. Consequently you victualled yourself and your men with what you dragged yourselves, in addition to what you shot?—Yes.

8735. Did you shoot much on that occasion?—We shot a number of hares and geese, and a few ptarmigan.

8736. With respect to fuel, how did you manage?—We had a little alcohol and a little tallow, and we picked up occasionally some wood. Perhaps an interesting fact that I may mention is, that had it not been for the sickness and the starvation of the Indians who were hunting for us, and also from the great thaw, a most unusual thing, which prevented our starting as soon as I wished we should probably have brought home very early news of Captain M'Clure's ship. Ten days before I got to Cape Baring, some of Captain M'Clure's people were at an opposite point, apparently not twenty miles distant, and had I not been obliged to hurry back in consequence of the lateness of the season, in all likelihood I should have been where the "Investigator" wintered, 1850-51, because I had abundance of provisions, and we were as fresh, and better than on the day we started.

8737. Were those men who accompanied you able to take part in your boat expedition?—Yes, they were all good boatmen in a certain way; famous in rivers.

8738. But the fatigue which they had gone through in the course of this journey did not incapacitate them for your further explorations?—Not in the least; they were quite able for any kind of work, and one of them, John Beads, was my chief guide and steersman.

8739. Will you state what was the nationality of those two men?—Those two men were both English half-breeds from Red River.

8740. Men whose diet had been throughout the whole of their life similar to what you were giving them at that time?—Possibly; but whilst at Red River they get an abundance of vegetables and flour; but when they are far in the interior in the Company's service they cannot get these, and, in fact, they do not seem to look for it, for bread at least, and they cannot get vegetables in many places.

8741. Referring now to that particular portion of diet, from your experience you have no doubt that a man can exist for year after year on fresh meat or fresh fish without the addition of any vegetables whatsoever?—As far as our experience goes, I think that is the case. I think in the more out-of-the-way parts of the country there are no vegetables. In many of the posts on the Mackenzie River they cannot grow any, and I know that none are sent in, because they are too heavy to carry. The only thing we could have there would be Edwards's preserved potato, but it is an immense distance to carry it, and it is never thought of, because they have never had any disease arising from the want of vegetables. Of course, they get berries occasionally, but that is not in the winter time, and it is usually only in small quantities.

8742. Then you went along the coast to the eastward in your two boats?—Yes.

8743. Accompanied by how many men?—I think I had twelve men.

8744. What was their food during that time?—

I see that our food was principally deer. We killed as many deer nearly as we wanted. I find that the consumption from the time we left until the time that we came back to the Coppermine was 180 lbs. of pemmican—a very small amount—and 450 lbs. of flour. We appeared to have enough; it was at the rate of about half-a-pound a day, and a quantity of fat which we used to fry our venison with. Some of this fat was derived from some mouldy pemmican that we did not wish to waste, and was boiled down to get the fat from it.

8745. Will you tell the Committee the date and the length of your boat journey on that occasion, and the days you were absent?—We left the Kendal on the 20th June, and came back to it on our return from the coast on the 4th September, having been absent 77 days. The distance of the boat voyage was upwards of 1,500 miles.

8746. When you got back, what was the state of the health of your people?—Perfectly sound, in excellent working condition. I may show you that they must have been so, for we kept continuously at work. We got into the Coppermine with our boats late in the autumn for that latitude; the winter was coming on; the birds were all migrating to the south; we left one of our boats, and took the other small boat with a double crew up the Coppermine, a most difficult river, and we took her right across to Fort Confidence partly overland, and through the lakes, then started to the south and kept going on till the winter set in and froze us up in the Athabasca river. We then as soon as the snow was deep enough, started (I did not wish to charge the Government with the expenses of these men all winter) and travelled upwards of 1,700 miles on snow-shoes to the Red River, and down to the States, the last 450 miles of which we did in ten days. We were helped by the dogs on this occasion, three of which had travelled the whole 1,250 previous miles; they had been all the time on the coast with us, and they were at the end of the journey when we reached Minnesota in perfect condition. One or two of the men who were with me all the way took great care, and did not overwork them. This journey of 1,700 miles was performed, I see, at the rate of nearly 27 miles a-day, counting only the days we travelled. We got fresh provisions at every trading post every six or eight days. I mention this to show that the men were in a perfectly good condition for all kinds of work. During the whole of the time they had no spirits of any kind, except a little at Christmas, and I do not think then more than a glass or two, and very little tea and sugar.

8747. Then you proceeded to explore the west coast of Boothia Felix; will you explain to the Committee your arrangements, and what you did on that occasion?—I can give you pretty full details upon the subject, as I happen to have the papers by me. The expedition of 1853-54 was got up by the Hudson's Bay Company at my own special request, and it was for the object of connecting the surveys on the west side of Boothia, several portions of which were still unfinished. I had hoped to do this by going in boats from York Factory to Chesterfield Inlet, and to cross over, or haul the boat over to the Great Fish River, and then proceed northward along the west coast of Boothia. I failed in this in consequence of the extremely rocky state of the land. I then pushed back down the inlet, and sent one half of my men with the small boat back to York Factory, and with the larger boat proceeded on to my old winter quarters at Repulse Bay. My provisions for eight persons, including myself, I find were of the same kind as before, the only addition being about 1 cwt. of Edwards's preserved potato, not from fear of scurvy, but because I thought it was an extremely portable thing to have with our pemmican. We had also on this occasion some extract of tea prepared for me by Dr. Bence Jones, which I found of great use, because we could always make a

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cup of tea with less than half the consumption of fuel, and in less than half the usual time; because we merely have to heat water sufficiently to be pleasant to drink, whereas, in making tea in the ordinary way the great difficulty is to bring the water to the boiling point, especially in very cold weather. Our rations during the winter at Repulse Bay, which we passed in a snow house instead of a stone one, the snow house being much the warmer of the two, were $\frac{3}{4}$ lb. of biscuit, $\frac{3}{4}$ lb. of chocolate, 1 lb. of flour, about $\frac{1}{4}$ lb. of grease, $\frac{1}{16}$ lb. of sugar, and $\frac{3}{2}$ lb. of tea a week per man; but no spirits or wine of any kind. We had venison *ad libitum*, with a change of fish occasionally. The provision store was put under the care of one of my most careful men, telling him how long our stock should last, and not to waste any; I believe that was a better system than issuing the regular rations. We never had more than two meals a day, and frequently for want of fuel we only cooked once a day. The winter was spent much in the way that it was done in 1846-47, except that we were more comfortable because we lived in snow houses. My own was very cold, because, as I did not smoke, and all my men smoked vehemently, I lived alone; the difference in the temperature between my house and theirs varied generally from 12 to 18 degrees; so that I may perhaps claim to have passed as cold a winter as any one ever did, the temperature frequently being 5°, 6°, or 7° below zero in my house. I say this because wherever there are Esquimaux, if there is a single man or single woman they all sleep together, and more than one live in the same house; therefore I was the exceptional case of living perfectly alone without any warmth of any kind excepting what was got from my own body. We had not much amusement but school. In both the winters at Repulse Bay I kept school. Pencils only could be used in writing, but the advances made by one or two of the men were something extraordinary. One went all through a complicated book in arithmetic; another, a half-breed that merely knew his letters when we began in October, was able to write sufficiently well to note the thermometer, and make notes of what took place in the spring, when left in charge during my absence, and to read his Bible pretty well. I merely mention this as being one means of passing our time apart from our hunting and the collecting fuel, which we used to scrape during the winter time from under the snow when we ran rather short. My journey in the spring of 1854 occupied 56 days. We carried with us what I considered provisions for 60 days at the rate of $1\frac{3}{10}$ lbs. pemmican, $\frac{3}{4}$ lb. of flour, 2 ounces nearly of preserved potato, $\frac{1}{10}$ lb. of tea, $\frac{1}{8}$ lb. of sugar, and $\frac{1}{10}$ lb. of chocolate per day per man. We had also on that occasion 12 lbs. of condensed milk, which was given to the men to use as they found it convenient, amounting to $2\frac{2}{5}$ lbs. per man, my party consisting of five people. It was on this occasion that we found the extract of tea so very useful. All the fresh food that we obtained was one small deer weighing about 40 lbs., and a very few ptarmigan. On this occasion this peculiar form of sledge which I have shown to the Committee was most advantageous, as it may be seen by the charts that more than 300 miles of the distance was across land where the snow always lies much more loosely packed than it is upon the ice. The result of this expedition, although the distance performed, including a preliminary journey, was about 1,100 miles, at the rate of something like 18 or 19 miles a-day, was not as satisfactory as I expected, having been able only to unite Dease's and Simpson's discoveries and those of Sir James Ross on the west coast of Boothia. On returning I found my three men left in charge at Repulse Bay, surrounded by Esquimaux, who had been living on the most friendly terms with them, and had not attempted or committed a single theft, although the whole of our goods, boxes, and other things, were exposed on the rocks covered with oilcloth: although those boxes contained all that

they most valued, such as saws, ice-chisels, scissors, files, and other things, that they knew of, yet not a single attempt at injuring or stealing had been made by these people, and there were at least 12 or 15 grown up men. I mention this specially, because some of the Esquimaux were those that must have been in the neighbourhood of Sir John Franklin's lost party, and because there had been a statement made that these Esquimaux had killed some of them. My reasoning was this, that if they had done so they would certainly have murdered my three men in order to obtain what was to them of much greater value than they could possibly have got by doing that injury to the white people to which I have referred. It was on this occasion that I also brought home the first information regarding Sir John Franklin's expedition, information which was subsequently proved to be perfectly true and correct, and it was information beyond what was subsequently ascertained. I heard of some of Sir John Franklin's party having reached the mainland of America, which the natives distinctly described as Noonah, as compared with the island which they called Kiaktak—King William's Land. We returned in the autumn to York Factory, all perfectly well and sound, not having had any disease of any kind, with the exception of one of my men, who had lost a part of his great toe by frost-bite, through his own carelessness. I went to England by ship from York Factory at the end of the season. It may, perhaps, be thought worthy of mention that the total expenses of the expeditions of 1846-1847 and 1853-1854 were less than 4,000*l*.

8748. Reverting to that portion of your letter which relates to your experience of scurvy on board ship, would you be kind enough to tell the Committee what you have seen of scurvy on board ship?—It is very long ago, and I can only speak from memory. I went out as surgeon in one of the Hudson's Bay Company's ships, that usually return every year after a voyage of four or five months. In this year, 1833, the ship could not get home; she was stopped by a perfect barrier of ice floes across Hudson's Straits. We made every effort of course to get home, because the captain used to get a gratuity if he did so. We persevered long enough, because before we bore up the vessel was set three feet down by the head by the weight of the ice that was hanging on her bows and on her fore-castle. We went back to an island called Charlton, in latitude 51° 45', and wintered there. We could not go to any of the Company's settlements, because on the breaking up of the ice, it usually comes down the rivers with such force, that it would sweep away any ship laid up in them. We therefore wintered at this island, on which there was no inhabitant, and we took possession of some old houses, repaired them and passed the winter. There were, I think, so far as my memory serves, about 22 to 23 of the crew, and 6 or 8 passengers, that had been going home from Hudson's Bay. I specially mention this fact, because we had very little fresh provisions, very little lime juice, and very little rum. It was then the habit, I think, to give rum as a ration to the sailors in that service. Our provisions were salt pork and salt beef, and a number of salted geese that we had got sent to us with biscuit and flour. We had, to the best of my memory, very little vegetables of any kind; we however, made spruce beer of the tops of the spruce trees, but notwithstanding this, from 15 to 17 people got attacked with scurvy, and in every case, except one, the symptoms were the usual ones; that is to say, redness, swelling of the gums, looseness of the teeth, spots on the limbs, and particularly the hams behind the knees gradually becoming quite purple and black, the legs got hard and swelled, and the knees bent; the state of the mouth was so bad, that in several cases the teeth might have been lifted out by your finger and thumb; in fact, one morning one man named Letham said that two of his teeth were missed, and he could not account

for them, except by his having swallowed them in the night. The only case that was exceptional was that of the captain, but he had, I think, something wrong with his lungs; so far as I remember, he had œdematous swelling of the legs. I do not think that his mouth was affected, but clearly it was scurvy combined with some other disease that he died of. The chief mate also died in the most fearful state that I ever saw any one. His skin was perfectly black; his mouth black; his saliva was as dark as ink, and the odour from him was so horrible that there was no person could come near him but myself. I was then a young healthy lad of 20 or so. I had to carry him out and into his bed, and the man who made up his bed when we moved him, got sick invariably immediately afterwards. This man died in a fearful state. Those two men, I believe, had taken more spirits than was good for them, and consequently, it was no wonder that they were more affected than the other men. We had only very little fresh meat sent to us from the nearest trading post; I do not think it amounted to more than 8 or 10 lbs. per man altogether. There was no game to be got, unfortunately, and in spite of everything we could do, giving them a few potatoes that we happened to have, cut in slices like cucumber, and put in vinegar, the men were all getting worse until the snow began to disappear, about the month of May. Then we discovered what we could not find out before, that the ground in many places was covered with cranberries, which we took to those men who were not able to walk, and the others who were able to crawl out, went to this place and fed upon them; consequently from that moment they began to recover. Our small supply of lime juice having long been finished, later on a wild pea or vetch which grows along the shore showed its little bud above ground; these we picked and made soup of, and this with the berries together, I believe, brought round the sick men. The whole of them at last recovered as far as scurvy-stricken men could do, although we had very little fresh provisions to give them.

8749. Your crew consisted, as I understand, of 23, and six passengers?—They were, so far as I could remember, from 22 to 24, and six or eight passengers. The curious thing was, and it struck me at the time, although I never thought about it before, that the men that had been in the Hudson's Bay service that were going home, did not suffer at all, or were very slightly affected by scurvy. I remember that, but I cannot tell you whether they were perfectly clear from it or not.

8750. It confined itself more to the ship's crew than to the passengers?—Yes, exactly.

8751. Were there more than two deaths?—No more.

8752. And you think altogether that 17, which would be about half, were afflicted with this disease?—More or less, some slightly; but they all had the full indications, that is to say, purple spots on the legs, even in the slighter cases, the gums being extremely delicate, and the teeth loose; blood came from their mouths, and they had purple and swelled gums, all of which are good evidence of scurvy, or, at least, are believed to be so.

8753. (*Admiral Inglefield.*) What species of snow shoes did you wear when you were travelling with the sledge, of which you have shown the Committee a drawing?—I never used them in sledging on arctic service.

8754. But on other journeys, when you used snow shoes, what sort were they?—I happen to have some sketches; one is a very admirable kind of snow shoe turned up at the point for travelling over lakes, or along the coast, because on a lake there are generally hard ridges, and with a flat shoe you strike against the ridges, and it is apt to make you fall (*the witness produced sketches of various kinds of snow shoes*). The flat snow shoe is best among woods, where the snow is usually deep and soft.

8755. These snow shoes were used only for exploring, but not when drawing the sledge?—I never used them; they can be used but I never required them. I regretted exceedingly not having taken them with me in 1854, in fact we stopped to make some out of one of our old sledges. We had them at winter quarters.

8756. What was the lowest temperature when you were in the hut, and when you say you were obliged to keep the door open whilst the cooking was going on?—Our lowest temperature there was either 47° or 50° below zero.

8757. And you had no lime juice then?—Not a drop.

8758. What substitute do the Hudson's Bay people use for lime juice?—None at all.

8759. Lime juice is not taken or supplied usually by the Hudson's Bay Company?—There is only one place where they have it in stock, and that is at York Factory, because there are no vegetables grown, and they have had scurvy because they have to live almost wholly on salt provisions occasionally.

8760. Your experience of the use of lime juice has been very limited?—Perfectly so.

8761. Of course you have been able to make no observation upon the method of carrying it or its freezing, or its ability to withstand the peculiar temperature of the Arctic regions?—I have only thought of it since I have heard the Government expedition spoken of. I had heard it spoken of before this last one, and I have had an idea about how I would do it. My plan would be to have flat tin bottles capable of holding three or four days' rations for eight men. These could be thawed each day over the cooking apparatus, and when empty thrown away.

8762. How many cases of scurvy have you seen in all?—Only those that I have described in 1833-4, 16 or 17.

8763. Since then you have had no experience of scurvy?—No, not the least, and I have no experience of how to carry lime juice.

8764. (*Dr. Fraser.*) In the outbreak which you have referred to, which occurred about 40 years ago, the men were on short rations, were they not?—They were not on short rations, but they had no fresh provisions.

8765. Can you recollect what they did have?—The provisions were salt beef, salt pork, and salted geese, with a ration of a pound of flour or a pound of biscuit.

8766. But no vegetables of any kind?—No vegetables of any kind, except towards spring, when we got some frozen potatoes; but those were so few that I cut them up in slices, with vinegar, and gave them to the sick men, without any very great amount of benefit.

8767. That is to say you only got vegetables after the scurvy had appeared?—Yes, after it had appeared.

8768. You had a little lime juice, I think?—Yes, we had, but I cannot tell you the quantity.

8769. Do you remember, or not, whether it was given regularly until the scurvy appeared?—It was not given regularly, because the voyage was only one of four or five months, and it was only carried as a precaution.

8770. The men were really living upon salt meat, which, I think you say, was abundant?—Yes, enough to give the usual ration, which was about a pound a-day, and a little flour or biscuit.

8771. But neither vegetables nor lime juice?—No.

8772. I have heard you mention pemmican occasionally; can you tell me how that pemmican was made, or what was in it?—The pemmican was made as the Hudson's Bay Company do it; it is dried either over a fire or in the sun and pounded; it is formed of either venison or buffalo meat. An equal weight of melted or boiled fat

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is poured over it; these are mixed together and put into a bag made of the skin of the buffalo or the deer, the flesh of which forms the pemmican; nothing else, except occasionally when you want to make it very fine, berries are put into it, but the pemmican generally used for voyaging has nothing added to it.

8773. What berries do you mean?—It is a berry called Saskatun or service-berry.

8774. What sort of taste had it; do you remember?—It is a berry much like the blaeberry of Scotland. It is very wholesome, of a blue colour with a bloom on it, and it is pleasant to eat; it is not very juicy.

8775. Is it tart or not?—No, it is not tart; it is sweetish, but not very; it is a berry that you can eat any quantity of without feeling any bad effect. It is like the blae berry in appearance, but larger and not quite so juicy.

8776. You did not use sweet pemmican, at all did you?—Never, excepting on Sir John Richardson's expedition, and he had it from England.

8777. But the pemmican which you have spoken about was the plain pemmican?—Yes, the plain pemmican.

8778. Did you find that you yourself and your men could generally continue to eat a large quantity of pemmican?—We were always hungry, and always ready for our food, and could eat much more than we carried, which was a small ration, for reasons I have already given.

8779. You, I think, told us what provisions you used when you were at the Great Bear Lake in the winter—8 lbs. of fresh meat per man per day, I think you said, was the ration?—8 lbs. of fresh meat per man per day without anything else.

8780. That was the only thing they ate?—Yes.

8781. Did they eat all of it?—Very generally; that weight includes bone.

8782. How was it prepared for them?—They boiled it; they had no means of cooking it otherwise. They may have roasted a little or fried it if they had grease.

8783. Was it ever consumed partially cooked, or was it always well cooked, do you think?—As far as I know, they ate it rather underdone, as many people would do beef here, but nothing more; never raw. One reason for cooking venison well is that the water in which it is boiled is a pleasant and nourishing drink.

8784. Did you find that a child could consume 2 lbs. a-day of meat?—I am told that they did. My belief is this, that when you have no vegetable or no bread, there is something that the system wants which is in very small quantity in animal food, and therefore you have to eat a very great deal more than you otherwise require in order to get this quantity from the meat, because we always found that a man would be quite as well satisfied with one pound of flour, and two or three pounds of meat, as he was with the 8 lbs. of meat alone; that is the general experience.

8785. The meat was generally reindeer flesh, was it not?—Yes, it was reindeer at Bear Lake, but the same ration as given in the Saskatchewan of buffalo meat.

8786. Is it the custom to eat the reindeer stomach with the half digested vegetable matter in it?—The Esquimaux do so, and the Indians I believe do also sometimes.

8787. Habitually?—I am not sure that they do so habitually; I have seen my hunter do it, and a very excellent hunter he was. He was a man who was accustomed to live about the Fort, and he used frequently to take a sup of the contents of the reindeer stomach, while it was warm from the animal.

8788. I have understood that they eat it raw?—I have never seen them eat it otherwise than raw, but of course I do not know from experience. The Esquimaux of Repulse Bay always have in the winter time, a piece of it lying at the door of their snow house

of which they cut off some when they are taking their food.

8789. Is it a part of their daily dietary?—It seems to be. I used to see it lying about constantly. I have seen them take up a piece and eat it; they seemed to take it whenever they felt inclined to do so. I did not trace it up sufficiently far to know why.

8790. May I ask if you yourself consumed 8 lbs. of meat a day?—I am not quite sure; I did not weigh it. I was never put upon a scale allowance in the way that the men were. When we went to Repulse Bay I did not weigh out the food; we just ate as much as we thought necessary. I do not think that I did eat it all. I think, perhaps, about 3 or 4 lbs. would have been quite enough for me. I shall hand in scales of diet that may show this.

8791. Do you know if this 8 lbs. is often or ever exceeded as a daily allowance by the men?—I have heard of 10 or 12 lbs. being given to some men, and that they felt hungry even after consuming that, but I have never witnessed it; I have heard it authoritatively stated that it is the case. Simpson mentions the case that one of his men, a Canadian, when he wintered at Fort Confidence, would eat about 16 lbs. a day if he could get it.

8792. Have you had any opportunity of observing the same men on a dietary which included vegetables?—I have not exactly noticed it as regards vegetables, because in the Saskatchewan, where they issue this 8 lbs. of meat, if there are any vegetables they get them over and above; they get potatoes beyond their quantity of meat; it is given gratuitously over and above their ration of 8 lbs.

8793. That is at a different station?—Yes, we never had it to give at the other place.

8794. I mean at a different time of the year have you ever noticed the same men who in one station consumed 8 lbs. of fresh meat, consume a ration consisting of fresh meat and vegetables at another station?—Not that I am aware of. I cannot fix upon any case. The only case in which I have seen a reduction in the meat was when we had flour to give them, and bread. It is not a question out there of scurvy, because the only place that I know in Hudson's Bay where scurvy has appeared is at York Factory.

8795. There are gardens, are there not, in some of those stations?—Yes, there is a sort of a garden even at York Factory.

8796. I suppose that sometimes they would have a certain supply of vegetable food?—I think not to the men generally. There is a little grown, perhaps, that the officers' mess have, but there is always on hand at York Factory, in case of scurvy, Edwards's preserved potato, and a large supply of cranberries; and whenever there is not sufficient venison to be got, as is often the case, they serve out these preserved potatoes and cranberries to the men.

8797. Is that because they generally find that if they cannot get fresh meat scurvy occurs?—Yes, that is the experience.

8798. And when they do not get fresh meat what is the meat diet?—Principally salted geese killed near the place, and salt pork imported from England.

8799. And these without vegetables, generally caused scurvy, did they?—That has been the experience there. I never was surgeon at York Factory. I only speak from hearsay, having wintered once there when there was no scurvy.

8800. You have, however, I daresay, seen men living upon fresh meat and vegetables in that country?—Yes, frequently.

8801. In these circumstances do they eat as much meat?—I cannot tell, I have not gone into the case. The ration that we give at the place I stayed ten years at, is a goose weighing some five or six pounds with a pound of flour, and I think when we had vegetables there was only five pounds of flour issued a week, and potatoes were given to make up the deficiency.

8802. In the very long sledge journeys, which you have had experience of, you were generally travelling with a dog sledge, I think?—On the arctic coast. Twice we had dogs, but on the last expedition in 1853 and 1854, we had no dogs. All our work then was done by ourselves.

8803. Which did you find was the hardest work, with the dog sledge, or with the man sledge?—It depended very much upon the ice. On the occasion when I went down the Coppermine River, the dogs were of very considerable service to us, because the ice was good, but wherever you have a great quantity of very rough ice, the dogs are not of much use. You can scarcely use them in fact.

8804. They stop, do they not?—They are very apt to do so. They are not so apt to stop with the sledge used by me, simply because it does not sink in the snow so badly, there is not such an immense drag upon it, but I have seen them stop at times, and we have had a great deal of trouble in getting them on.

8805. You appear to have got over a good deal of ground every day, however, whether with the dog sledge, or with the man sledge?—Yes we did.

8806. I suppose as a general rule, you avoided fatiguing the men much, did you not?—No, we travelled generally about ten hours a day, and we never stopped. Immediately before starting, we had breakfast, and the best breakfast we found, was a pint of tea with a piece of frozen pemmican without anything else, but on the last journey when we had biscuit we had half a biscuit with it. A part of this supply of pemmican each man put in his pocket, or in his coat somewhere, and he ate it when he pleased. We never stopped except for a few minutes to take what the men in the Hudson's Bay call a pipe every hour or so, that is to say a little rest, which was longer or shorter, according to the severity of the work, but went on from ten to eleven hours, sometimes more, and sometimes a little less. We then prepared for encampment by building our snow-house, cooking our food the while, which in the evening was almost always pemmican, boiled with some flour, or in 1854 with some preserved potatoes; as we could not generally cook our food and have tea at the same time, we had a drink of cold water to finish off with before going to bed. Whenever we could have fuel enough, we took tea also.

8807. You never carried alcohol, did you?—No, except for fuel; we never tasted it.

8808. Why was that? Was there any special reason why you did not?—No, except that I think it is a bad thing. We never give a ration of spirits in any part of the Hudson's Bay Company territory that I have known. For the last 30 or 40 years there has not been a drop of spirits or wine admitted into the whole of that large district (the Mackenzie River), larger than all Britain, for man or officer, or the Indians.

8809. Is that because it was found prejudicial to the physical condition of the men or to their moral condition?—We were desirous of stopping it from the Red Indians, and we would not allow them to say that the white men brought it in for themselves. The usual allowance was done away with, and no allowance was given even to the officers. I wish to say I am not an abstainer myself, I take my wine, and therefore there is no feeling like that of a total abstainer about me in this question; it is merely my belief that it is a bad thing, and that it does harm. I may further add that when travelling, not on arctic service, but when on long snow-shoe journeys in the country, I have often offered men a glass of grog, knowing them to be fond of it, in the day time whilst they were working, and they would shake their heads and say, "No, I thank you, I will take it, if you please, when I go to bed at night."

8810. They would not take it in the day time, knowing its bad effect in travelling, having found that they really did not work so well after it?—That was their idea. Men that I know were extremely partial to it declined to take it in the middle of the day, before their work was done.

8811. When you made your long sledge journeys, did you ever halt for a day or several days during the journey?—We were obliged to halt by stormy weather sometimes, not necessarily from fatigue, but because of snow storms coming on, during which we could not travel.

8812. Did it result, as a general rule in the long journeys, that you had halts of several days?—Occasionally. I see that in the journey of 1851 I was stopped three days by stormy weather out of 47 days.

8813. Do you think that those halts were beneficial so far as the condition of the men was concerned?—We thought them a great annoyance at the time, because we were eating up food that I thought we might get further on with. They certainly may have been a relief now and then, but I think not generally; we would rather we had not been detained.

8814. Do you know how the extract of tea was made that you have told us about?—It was proposed by Dr. Bence Jones to me. He got it done himself. He made a very strong decoction of some excellent tea and evaporated it, and it came out a brown powder.

8815. Is scurvy a very common disease in the Hudson's Bay territories?—I have never heard of any cases of it, except at York Factory.

8816. Was the dietary at York Factory the same as you have told us about, at the time this outbreak took place?—The dietary there was salted geese, and salt provision principally, and this scurvy occurred generally when they were unable to get sufficient venison to keep them in frequent rations of fresh meat instead of salt. They cannot always depend upon getting deer; sometimes they pass in great numbers, but at other times there are very few to be got.

8817. (Dr. Donnet.) You have expressed the opinion that a large quantity of meat is required where vegetables or flour do not form part of the dietary; for what length of time have you known men to live on an exclusively meat diet, such as you have described?—I could not answer that question, as to continuous living. I know that we passed a whole winter of 6 or 8 months or so, without having any vegetables or any farinaceous food.

8818. Not even during the summer months?—I cannot say the continuous time, simply for this reason, that the men travel in the summer, and sometimes they get a few vegetables, and sometimes they get flour, and therefore I cannot say positively, but I can get information upon that subject.*

8819. Have you yourself been for any length of time on fresh meat provisions without any vegetables?—On all these expeditions except the last, we had no vegetables, that is to say for 14 or 15 months.

8820. At one time?—Yes, at one time. On leaving York Factory, in the year 1846, I had no fresh vegetables of any kind, until we got back there nearly 15 months after.

8821. During that time, had you nothing in the shape of fresh vegetables?—Nothing.

8822. What drink was taken by you mostly?—Tea, a little chocolate, and water.

8823. On your travels did you ever meet with fir trees?—We had abundance of fir trees about Fort Confidence.

8824. Do you know whether the fir tops were eaten by any of the men?—No, never.

8825. Was spruce beer ever made?—We made spruce beer in 1833-34 for the sick men that had

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* See Extracts of Letter from Mr. Robert Campbell sent in. (Appendix 28).

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scurvy as long as we had any sugar to put in it, but we ran out of sugar.

8826. But you had spruce beer during the expedition that you have described?—No, we never had spruce beer on any expedition.

8827. You say that in 1848-49 you were with Sir John Richardson?—Yes.

8828. And at that time you gave 8 lbs. of fresh meat to each man, or 4 lbs. of half dried meat, and 10 lbs. of fish as a ration?—About 10 lbs. The fish were not weighed; three large fish were given out, which would weigh probably fully 10 lbs. or 12 lbs.

8829. What effects did you find upon the men after having so large a diet, especially of fresh meat?—They were in excellent condition. We always found that the men who had lived all the winter on fish looked fresher and healthier, and their skins were fairer than those who had lived on meat; but I think usually the men living on meat were the more wiry perhaps. They were less encumbered with fat, but they were darker and not of so good a complexion.

8830. What is the nature of the employment of those men whilst they are on this large meat diet?—They are usually employed in cutting timber, cutting wood for fire, attending the nets, hauling home, in the meat districts, the meat from the plains, snow shoe walking, carrying expresses, and things of that kind. It is pretty hard work, but not very severe.

8831. I believe Sir John Richardson was at Fort Confidence with you, was he not?—Yes, the first time in 1848.

8832. Did he live upon the same diet?—Exactly as we did. Of course the officers had a little, but very little more variety than the men. We had more flour than the men had in proportion, but it was very little.

8833. Can you remember what amount of fresh meat Sir John Richardson ate?—I could not exactly say. The meat for our mess was served out in a certain quantity. I can give the details, because I have them. of the daily supplies to the men.

8834. Did Sir John Richardson ever express surprise at the exemption from scurvy under a diet so entirely free from vegetables as you describe it?—Not to my remembrance.

8835. Did the men never feel the want of vegetables after having been for so long a time on fresh meat?—I have never heard them express any longing. The longing that I had at Repulse Bay was for cranberries to eat with my venison, but I cannot remember that the men expressed any particular anxiety to get vegetables.

8836. Have you ever asked yourself as a medical man the reason of this exemption from scurvy amongst men so entirely deprived of vegetable food as your men were?—I have not gone into the question. It is only of late years that I have read about it, since coming to England. I have thought it a strange thing, but cannot in any way account for it. The facts are as I have stated, and I am certain that you will find on enquiry that our men have lived for years, without ever having any vegetables, except perhaps a few berries in the summer time. One very strong point, I think, with our people is that they have never been accustomed to have a ration of spirits. In expressing this opinion, I am merely speaking of what I have seen; and knowing the bad effects of rum, I am quite against it in a cold climate.

8837. Is it not an universal medical opinion that scurvy can only be caused by the absence of fresh vegetable food, and that it will not occur if an adequate amount of fresh vegetable food is supplied?—I have understood so.

8838. The exemption from scurvy in your case seems a little remarkable, does it not?—It is curious enough, but I can only state the facts. The few cases that I gave, seem to me important now inasmuch as they got better upon a treatment of cran-

berries, and this little vetch, of which I have already spoken.

8839. Would the scurvy have been prevented, had the men taken cranberries or other vegetable food with their diet?—I feel almost convinced that it would have been so, simply for this reason, that although their diet was not much changed, so far as their food went, they quite recovered by adding cranberries to it, although they had contracted the disease. Therefore had they been supplied with an adequate amount of cranberries before hand, I think it would have prevented the disease appearing, at least, that is my impression.

8840. Have you made yourself acquainted with the history of the late expedition?—I have read nearly all that has appeared upon the subject.

8841. Can you account for the outbreak of scurvy upon that expedition?—No, I am afraid it would be impossible to do that. Of course, I am giving my opinion with great diffidence, because there are other observers, medical gentlemen, who are much more competent to judge of it than I am; but I think it may have arisen in great measure from a great variety of little circumstances. I think that possibly the men may have had rather too little to do in the winter. I gave my men a very considerable amount of hard exercise in the winter. There are a few things that I might mention. I think that the double allowance of grog was bad, and that giving them a double allowance of lime juice just before starting on sledge journeys, and then stopping these allowances, was a bad thing. Another was, their stopping to take tea in the middle of the day was a bad thing, because however good the tea is, their standing in the cold for an hour and a half exposed to the extreme cold, after perspiring very freely, must have been injurious, causing stagnation of the blood, I should suppose; it is a thing which I at least should not have done with my people. Also their mode of shelter in a tent was bad. Wherever we can get snow either to build a proper snow house, or to build a snow shelter, it is better than a tent which is extremely cold, and otherwise bad, because the vapour of the breath gets condensed on the tent and on your bedding, and it makes the bedding what Captain Markham said in his graphic account before the Geographical Society, like a sheet of iron. When you use snow as a shelter your breath instead of condensing on your bedding gets condensed on the walls of the snow house, and therefore your bedding is relieved from nearly the whole of this. I think that their work was excessively hard, partly from the peculiarly soft state of the snow and from the exceptionally rough ice that they had to pass over; their sledge loads were immensely heavy, because they had at least upwards of 80 lbs. of constant weight for each man to haul; supposing that all the provisions that they had, and all the fuel were consumed, still they had 80 lbs. to 90 lbs. to haul for each man. My men by the arrangements that I had, namely, carrying no tent and very little bedding, had not more than 40 lbs. each man to haul, after our provisions were consumed. This was a great relief to them, and of course they had very much less exertion to use. I consider also the mode of sleeping in the blanket bag a very bad one, because it separates the men from each other, and they cannot communicate the heat from one body to another. My own plan was this, we lay 4 or 5 of us together. I lay on the outside, and the man who was to cook next morning lay on the other outside, whenever the "outsides" felt cold, we gradually got into the habit of putting about, that is to say, of all turning on the other side and thus warming the side that had been before exposed, and we lay as comfortable as possible. We frequently thawed snow for our drink in bed between us, and as I have already said we never slept cold in the snow house, except once, although we only had one single blanket over us. Instead of putting on a coat to sleep in,

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we always took our coats off, simply for this reason, that if you have a great thick coat on, it keeps your arm from your body and you have not any heat communicated from the body to the arm. The Esquimaux who is a very knowing man, takes off both his coats and he has nothing on his upper parts at all, and therefore he lies with his arm close to his body, and as near his neighbour as possible, that the heat may communicate from one to the other. If you have got an immense duffle blanket separating you from your neighbour, and if you have got an immense duffle coat put on yourself, separating your arm from your body, and you lie with both the coats impregnated with snow, the result must be most injurious to anybody, and prevent him from sleeping. It may be said, *that these of the late expedition experienced more cold than we did*, but the greater the cold the more necessity was there to establish either a snow house or to build a snow shelter. A snow house they may not have been able to have built, but when the snow was not packed enough to build a snow house with, there was always an abundance to build up a snow shelter, which is a thing easily done. The walls are built up in little time. You dig out a place three feet deep, and the snow is taken out; then, if you build a wall three feet higher, you have a shelter. Lower the foundations two or three feet, and then build a three or four feet wall above, and cover it with a piece of sheeting; that is what I should have done if I could not have built a snow house properly.

8842. What time does it take to build a snow house?—It varies. We have had ourselves housed in 25 or 30 minutes in a three-man house, which is very fast. It is sometimes longer and sometimes less, but a little more than an hour for a five-man hut would be about the average. It is said that this is a long while to lose, but then we should remember what the advantages are—you have no tent to haul; you have but little bedding comparatively; you have no tent to pitch; you have no tent to take down in the morning and pack up, all covered with condensed vapour sticking to it; whereas we with the snow house, if it was bad weather, took our sledges inside and packed them under cover; if we come back the same way, we occupy the house again, so that we have no trouble in building another. In mentioning this I am merely mentioning my own details. I am not wishing to say that they are better than others, but I want to show the way we did, and the reasons that made me do so. I have often heard complaints about the state that the bedding gets into. I have mentioned something which I consider the reason for it, and the reason why, by this lighter equipment and by using the flat sledge,—for I have tried both kinds,—I found that we could travel so much longer. Then the sledge that I have pointed out has another advantage. When we got near the end of our furthest point we could cut a piece off one of them and use it for fuel, and so shorten and lighten it. Then when we got a little lighter we could put two loads on to one sledge, and then that sledge was double-manned. If we came to a bad bit of ice or bad snow, we put the two sets of men on it; if it was good walking the men took the sledge alternately, and thus came back so rapidly that we made up for lost time on the outward march.

8843. In these snow huts was there much moisture?—No moisture at all.

8844. Did you remark any moisture in the huts usually occupied by the Esquimaux?—There was little or no moisture from the snow hut, because when it begins to drop you have nothing to do but poke a hole through the roof with a stick and the cold air comes in, it then gets glazed inside like glass. A snow house that has been occupied some time by the Esquimaux is glazed over, but they do not care about that, because it makes the house colder, ice being a better conductor of caloric than snow.

8845. Can you explain the manner in which the

Esquimaux live in their snow huts, and how they build them?—It is a simple thing when seen done. You select a piece of snow that is packed hard enough to walk over. It should be packed pretty hard, but still it should be so soft that you can cut it out with a saw. You cut out a lot of pieces of about two and a half feet long, 15 inches deep, and 6 inches thick. The Esquimaux generally cuts out all this from the interior of his house, and he builds it up similar to a beehive, he builds it up from the inside, and puts in the key of the dome, and then cuts a door out from the inside, and comes out. He then builds his bed, and when he is going to remain any time in the house he makes his bed a few inches higher than the top of the door, the object being that it should be raised above the draught of the door. It is just a bank of snow, and they lay on it, deer skin or musk ox robes, but invariably it is some inches higher than the top of the door, so that the cold air may not reach them, and they lie in the upper tier of air. They are very particular in that, and further they are so scientific that they know that if they made ice of their snow walls they would make the house colder. I once proposed putting some water on the weather side of my snow house which was being cut away by a gale of wind and drift, but the Esquimaux with us said, “do not do that, you will make your house colder.” They live in these houses and pass the winter very comfortably; if there are a few people, as there almost always are, in an Esquimaux hut, it helps to keep them warm. There is also the peculiar fact that they go to as great a depth for the snow as they can. If they come to a large drift bank, say about 12 feet deep they do not take the surface snow, although it may be perfectly good for building, but they will go down several feet to get to a kind of granular snow, and they build of this. They say that such a house is much warmer than one built of fine grained snow. It is a curious fact for study, because I could not make out the reason, and I do not know it yet; they generally go to this deep snow, so as to build what they call a warm house in which they intend to live for some time.

8846. How are these snow houses warmed?—In no way, except that the woman of the house has a stone lamp in which she has oil and a few pieces of moss burning. This is not of necessity for warming it I think, but for light.

8847. How many individuals live in one snow hut?—I have seen six or eight.

8848. What is the cubic space of that hut?—For six people I have seen a house about 12 feet to 14 feet in diameter, being perhaps, from 6 feet to 7 feet high.

8849. Was the air pure?—Not always very, but much purer than the houses of some of the poor in England.

8850. Do the Esquimaux suffer any inconvenience from this impure air?—No, not the least, the snow is sufficiently porous to admit of air, and yet not sufficiently porous for you to feel any draught. I know that by my winter quarters, for I had a lamp which was on the north-western side of my house. The winds were nearly always from that direction and the south-eastern half of my house got black inside, whilst the side towards the north-west was quite clean, simply shewing that the smoke of the lamp was carried towards the south-east although no draft was felt.

8851. What was the thickness of the snow walls?—About 6 or 7 inches, and it is so translucent that you can see to read and write inside quite well by the light that comes through the wall, if it is daylight outside.

8852. What food are the Esquimaux able to obtain?—In the case of those at Repulse Bay, the principal food is venison and musk ox throughout the winter.

8853. To which do they give the preference?—

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The musk ox they said was the best; they prefer musk ox to anything else when it is fat, and they prefer venison next, and then seal, and walrus after that.

8854. Do they ever eat any of the flesh of the bear?—Whenever they can get it; they like it very well, but I do not think they care as much about it as for the other flesh.

8855. What kind of birds do they get?—They do not kill very many birds; they get Hutchins' geese and eider ducks, they get a good many eggs, and also a great many salmon in the spring.

8856. Do they obtain any other fish?—Trout in the lakes. They catch the trout by angling, and the salmon by spearing. They have no nets, but as soon as the salmon come in to the coast when the ice goes away in spring they build a little stone wall at the mouth of some stream that is not large enough for the salmon to get up, and where there are pools of water remaining inside of where the wall is; the fish at high water come up to the mouth of these small streams, and as the tide ebbs, they are left inside this wall, and the Esquimaux go and spear them with a most curious and very ingenious spear. They kill a great many, generally ranging from about 18 lbs. down to 5 lbs., and they eat them almost always raw.

8857. Is whale's flesh eaten?—It is, but they have not killed any at Repulse Bay, for a great many years. They said they used to do so. It requires a large party to do it. They kill the walrus frequently, and the bear and the seal.

8858. Do they ever kill the white whale?—Not there; they kill a great quantity of white whale near Churchill, which is far to the south, and a very interesting sight it is to see them do it.

8859. Do they eat the flesh?—Yes.

8860. Is the blubber eaten?—Yes, they always eat the blubber with the flesh of all those creatures. At Fort Churchill there is always a quantity kept in hand of the fins and other favourite parts of the white whale in case the Esquimaux may starve, that is for the Esquimaux who are half domesticated and within reach.

8861. Have you ever heard of an instance of cannibalism amongst the Esquimaux?—I have heard of several, and I have one authentic instance so far as we can have authentic cases, in some of those people whom I saw in 1847. They had a very great dearth of food between 1847 and 1854, during which time about 50 of my old friends had died, men, women, and children, and there were two women pointed out to me that had recourse to cannibalism to keep themselves alive. Of course I do not know that of my own knowledge, but as the others specially pointed to them, and as they were rather in disfavour I believed that it was so.

8862. Then I understand you to say that you have never met with a case of scurvy nor heard of one occurring among the Esquimaux?—Never in my own experience. I saw I daresay hundreds of them, and there was no indication of scurvy amongst these people. These people had this custom, and it was the only case that I know, of eating the contents of the reindeer's stomach that I mentioned before; of course I only speak of those that I have seen.

8863. Of what do those contents consist?—Of mosses and grasses; it is not unpleasant. I have eaten some of it myself.

8864. Is it eaten as you find it, or is it prepared for the purpose of eating?—I never saw it prepared. You chop off a piece with a knife, and eat it as you would a piece of bread. I never saw it prepared in any way.

8865. What does it taste like?—It has rather a curious taste. I did not like it much. There was a little animal taste about it, probably from the mixture of juices from the stomach of the animal, but it was not unpalatable at all. I could have eaten it if it had been essential as a vegetable diet, and I fancy if it had been requisite for me I should have enjoyed it

just as we enjoy fat substances there when they are wanted.

8866. Can you tell me what other diseases the Esquimaux are subject to?—The principal disease that I saw was very like influenza, chiefly coughs and colds. As far as those people were concerned, I saw nothing wrong with them. Of course, one meets with ophthalmia, which is a matter connected with the bright sun on the snow. You always heard them speak of those who had died that they had those symptoms so far as I could make them out. I had no bad cases under me. Nobody died while I was there.

8867. You could not say whether it was phthisis?—No, I never saw any symptoms of phthisis. I have seen all ages, from very old men down to young children.

8868. What are the vegetables that the Canadians live upon in the environs of your forts?—Potatoes when they can get them.

8869. Do they cultivate any other vegetables?—Yes, they do sometimes, cabbages and carrots, and other things, wherever they will grow, but as a ration I do not think that there is anything that I remember, being served specially, except potatoes. They may have had a small amount of other vegetables but they are never grown to any large extent.

8870. On Mackenzie River, do they cultivate potatoes?—Yes, as far as possible.

8871. In any quantity?—Sometimes we get them in quantity, and sometimes, owing to the frost, it is a failure, but as a rule we can grow them.

8872. I understood you to say that your actual trial of complete abstinence from alcoholic liquor was favourable?—Yes.

8873. Did you ever give it in travelling as a medicine?—I always carried it as a medicine. I had a little in the arctic, but I never gave it except sometimes, I might if a man had a little stomach-ache. I do not remember any case where it was given. The reason I carried it was, as a medicine, and to give a glass or two at Christmas time and New Year's Day, but never to give it regularly.

8874. Did they not enjoy it at that time?—Yes, very much; they were all men that could drink spirits, and I was not restricted as to quantity. I might have had anything I liked to take with me, but I did not take it, because I thought it was best to be without it.

8875. You consider that rum is not a necessary article of diet on travelling and sledging parties?—I do think so; I never take it.

8876. (*The Chairman.*) Is it your opinion that scurvy is a blood disease caused by a deficiency of vegetable food?—I consider it a blood disease caused by a deficiency of something that it gets from vegetables; there may be something that may be equivalent to vegetables, that may be taken, but it is the same thing.

8877. And that cold, fatigue, malaria, syphilis, etc., may aggravate the malady, but cannot alone produce it?—I should say, from my experience, that those alone would not produce it. I cannot think so. My men have worked very hard at times, especially in that case where I mentioned that we were so very short of provisions, and yet there was not a symptom of anything of the kind. We had no vegetables, and nothing there to prevent it.

8878. Fresh vegetables and fruit, or their substitute, lime juice, prevent scurvy, and also alone can cure it?—My experience would confirm the opinion that fruit would cure it, but I have no experience of lime juice, because we had not sufficient to cure it with.

8879. Have you read the reports of the sledge journeys performed by the late arctic expedition, and how do they compare, in point of difficulty, with those performed by you, first, as regards the land journeys, and, secondly, as to those over the ice to the north?—I should say that Captain Aldrich's, along

to the westward, very much resembles, in some respects, my journey of 1854, because I had exactly the same difficulty on going over the land snow. Our legs used to go down; there was a little crust, just nearly sufficient to bear our weight, and our legs sunk to the knee or more, and therefore it must have been something of a similar kind to what they have described; but then we had an advantage over them, that our sledges did not sink; our sledges kept on the top of the snow, so that there was not that difficulty. Then, as regards Captain Beaumont's, that was rather different, although there was the same thing. I believe that a great deal of the difficulty would have been overcome if he had had snow shoes and had been sledging with sledges such as mine that did not sink. Then I had the great advantage that we had so much lighter weight to haul, not much lighter in food, but we had lighter bedding and no tent.

8880. As regards Lieutenant Beaumont, do you think the difficulties which he encountered were greater than those which you encountered?—I should not have carried the work out in the same way. Had I been in the difficulties that Lieutenant Beaumont was in, I should have taken the things on our backs, as we did when we found the dragging bad. I would not have gone on in the same way. The natural difficulties were probably greater than what I experienced, except when we carried provisions and everything on our backs. It must be remembered that men, sick and disabled by disease, find almost insurmountable difficulty in what to a healthy active man would be no difficulty at all.

8881. Now, what have you to say as regards the journey north across the ice, Captain Markham's journey?—It is very difficult to give an opinion under the circumstances, because there is nothing could have been worse than the ice that we had to go along to the west of Melville Peninsula. We could not take the sledges at all, it was so difficult. We were going over great hummocks, the snow lay between those hummocks, and you got deep into it, and often up to the knees in water besides, and that with loads of about 70 or 80 lbs. on the back, which we would not have carried if we could possibly have taken sledges; it was very fatiguing. As I said before, the peculiar sledge that Captain Markham used was very bad for hummocky ice, because the moment it went down off the hummock, it stuck into the snow, if there was snow below, and, as some one told me, the work of lifting the head of the sledge out of the snow was like tearing one's arms off.

8882. So that on the whole you would say that he encountered very much the same style of work as you did?—Yes, the regions that I reached were

far south, but I am speaking of the difficulties, and they were the same kind of difficulties. We never had to make double trips. Captain Markham had an immense load; he had to carry two boats; it is really fearful to think of. I was summing it up the other day from papers that I saw, and I found that really he had over 400 lbs. per man; he might have made it 200 lbs. by double-manning the sledge, but if you sum up the amount that he had to drag, the total is 405 lbs. per man when they had both the boats to haul.

8883. In your sledge journeys none of your men were attacked with scurvy, or with the symptoms which you would now be disposed to consider scorbutic?—None, not a single case.

8884. To what do you attribute their immunity from scurvy?—I think something was due, perhaps, to their previous mode of life, to their being accustomed to the work, and not, perhaps, having such unnecessarily heavy loads to drag. Those may be some of the causes; I am not aware of anything else.

8885. Have you any ground for supposing that from the natural anxiety to get through as much travelling as possible, the sledge journeys at first made on the recent arctic expedition were longer than those which subsequent experience proved to have been expedient?—That is a question which I could scarcely answer. I think it is just possible that when they had those very heavy loads, they may have injured themselves; but before I started I practised all my men, so that they did not feel the weight at first. I had a sledge made up to the weight, so that they got a little accustomed to it before starting. We made pretty long journeys from the very beginning with our heaviest sledges, not so long as we did latterly, but we travelled 12 or 15 miles a day and more with the sledges on first starting.

8886. Assuming that a daily allowance of lime juice could have been administered to the sledge parties of the recent arctic expedition, is it your opinion that the outbreak of scurvy would have been delayed?—I should say that it would have been not so severe as it had been, and that lime juice would to a great extent have ameliorated it, and it is probable that it would have been delayed.

8887. Are you further of opinion that it might, or would have been averted altogether?—I am not warranted in saying so much, simply because my personal knowledge of the effects of lime juice is not great, in fact, nothing. I have not had sufficient experience to give an answer of any value, and were I to say so it would be speaking of what I know nothing about personally.

(For the diet he recommends, see Appendix 29.)

The witness withdrew.

THOMAS MITCHELL, ESQ., Paymaster, R.N., *examined.*

8888. (*The Chairman.*) On what day did you join the "Discovery," and in what capacity?—As Assistant Paymaster in charge on the day she was commissioned, the 15th of April.

8889. Did you belong to her until she was paid off?—Yes.

8890. (*Dr. Fraser.*) I think when in winter quarters, vegetables were served to the men every day, were they not?—Yes, every day.

8891. Are you prepared to tell us what vegetables daily?—On two days there were potatoes, on the third day carrots or onions, on the next day compressed vegetables, then we commenced again with potatoes or carrots or onions, and then dried vegetables.

8892. Potatoes were three days one week, and four days the next week?—Yes, four days one week, two days in the week carrots or onions, and the remaining day dry vegetables.

8893. The preserved vegetables were always carrots and onions, were they?—Yes, carrots or onions.

8894. Those were the only two kinds that you carried?—That is all, including the dried vegetables.

8895. What was the ration of preserved potatoes per day?—Potatoes a quarter of a pound on the day on which it was issued.

8896. (*Dr. Donnet.*) Was any objection made by your messmates to any particular part of the diet in the diet list?—No, not to my recollection.

8897. Was any objection made to the salt meat? They complained that it was hard and salt, more so than the usual navy beef.

8898. Did you leave much of it behind?—So far as I know, they all ate their ration.

8899. Was the salt meat all taken up?—Yes, all taken up.

8900. It was stated in evidence, that an objection

J. Rae,
Esq., M.D.,
F.R.G.S.

31 Jan., 1877.

T. Mitchell,
Esq., Pay-
master, R.N.

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Esq., Pay-
master, R.N.

31 Jan., 1877.

was made to the meat, owing to its being so very salt?—Yes, but still they ate it.

8901. Are you certain of that?—To the best of my knowledge they did; they may have thrown it away; it was issued to them.

8902. Did you yourself eat it?—Yes.

8903. And did all your messmates like it?—They all ate it; it was always eaten.

8904. Was there any objection made to the corned pork?—None whatever.

8905. Was the diet considered by all of you to be very good?—It was all considered good.

8906. Did you all like it?—Yes, we liked it.

8907. Did you like the minced collops?—I preferred anything else. Some of the officers did, and others did not.

8908. What was the objection they made?—I think they did not like them; they would have preferred other things.

8909. Was there any objection made to the ox cheek?—None, they were very good indeed, very nice.

8910. I would like to ask your opinion about the whole of the diet supplied to the ship—did you consider it good?—Very good.

8911. Sufficient for maintaining persons in good health?—That I cannot say.

8912. (*The Chairman.*) What is your opinion of the salt beef as compared with the ordinary salt beef of the Navy?—It was not nearly so palatable.

8913. Would you say that there was as much nutriment in it?—Possibly there may have been as much nutriment, but it was not so nice to eat.

8914. We had complaints from one or two witnesses who said that the salt pork was fishy. Did you hear anything of that?—No.

8915. That is not your experience of it?—No.

8916. As to the ox-cheek, have you any opinion about it?—It was very good indeed, and it was generally liked.

8917. (*Dr. Fraser.*) The preserved potatoes were Edwards's, I suppose?—Yes.

8918. That was the only kind which you issued?—I believe it was.

8919. And it was one quarter of a pound per diem whenever there was a ration?—That was all.

8920. What kind of chocolate was used by the sledging parties?—Soluble chocolate.

8921. That is not the chocolate mixed with milk, is it?—No, not the chocolate in milk.

8922. Among the store of provisions, there was a large quantity of condensed milk, was there not?—In the officers' mess.

8923. Was it only in the officers' mess?—I think in the medical comforts, there was some.

8924. You do not know if it was ever issued as a ration?—Never.

8925. (*Admiral Inglefield.*) Had you more than one kind of pemmican in the ship, do you remember?—We had both sweet and plain.

8926. But there was no pemmican that was cured with raisins and currants in it?—No, there was some that we got at Polaris Bay, which was a little different from our own.

8927. Can you describe that difference?—I have never seen it.

8928. Do you think that any of that Polaris Bay pemmican would now be at Deptford?—No, I think not.

8929. Was it all consumed by the party?—I think it was all consumed at Polaris Bay.

The witness withdrew.

Adjourned.

WEDNESDAY, 21ST FEBRUARY 1877.

PRESENT:

ADMIRAL SIR JAMES HOPE, G.C.B., in the Chair.

ADMIRAL SIR R. COLLINSON, K.C.B.

VICE-ADMIRAL E. A. INGLEFIELD, C.B., F.R.S.

JAMES J. L. DONNET, Esq., M.D., Inspector-General of Hospitals and Fleets, R.N.

THOMAS R. FRASER, Esq., M.D., F.R.S.E.

H. J. VANSITTART NEALE, Esq., Secretary.

SIR ALEXANDER ARMSTRONG, M.D., K.C.B., LL.D., F.R.S., Medical Director-General of the Navy, *examined.*

Sir A. Arm-
strong, M.D.,
K.C.B.,
LL.D., F.R.S.

21 Feb., 1877.

8930. (*The Chairman.*) You hold the position of Inspector-General of Hospitals and Fleets, and Medical Director-General of the Navy, and are a Fellow of the Royal Society?—Yes. My rank in the Service is that of an Inspector-General; but I am now Director-General of the Medical Department of the Navy, which is a civil appointment.

8931. Be good enough to enumerate your service in the arctic regions?—We left England in the "Investigator," in January, 1850, in search of Sir John Franklin. We crossed the Atlantic, and, passing through the Straits of Magellan, entered the Pacific, where we encountered extremely bad weather for a period of nearly five weeks, during which there was a constant succession of heavy gales, and the ship was wet and moist throughout; very frequently battered down; and altogether a most uncomfortable state of things existed until we came under the influence of the trade winds, when we had continuous fine weather until we reached the Sandwich Islands early in July. During this voyage, of nearly six months' duration, we were twice dismayed by the violence of the gales. After a short delay of three

days, in the Sandwich Islands, we proceeded on almost a straight course to Behring Strait through the Aleutian group of islands, and entered the ice, I think, on the last day of July or the 1st of August. We proceeded along the coast of North America, where we were likely to meet, and where we did meet with Esquimaux. During that voyage we examined all the prominent points on the coast, and frequently landed a party, of which I was always one of the officers, with a view of obtaining intelligence. We encountered very great labour and hardships, night and day, in the working the ship through the ice, whereby the physical powers of all hands were very severely tested indeed. Very frequently we were beset with ice, and the safety of the ship and all hands was often endangered. We reached Cape Bathurst in due course, and, under favourable circumstances, we struck off to the northward and sighted land hitherto unknown. We followed the lead of that land, being in the same meridian as that discovered by Sir Edward Parry in 1819, and called Banks' Land. Following the coast of that land, we discovered and entered a strait, on which we subsequently

bestowed the name of Prince of Wales' Strait. We made numerous efforts to pass through Prince of Wales' Strait in the hope of getting into the Strait of Barrow, and thereby establishing the existence of a north-west passage, but in spite of repeated and most energetic attempts, under circumstances of great peril, we did not then succeed. We were always beaten by the ice, and during that winter the ship was in a most perilous condition day after day, constantly drifting, and all hands on deck frequently in momentary expectation of being obliged to abandon her, owing to the heavy pressure of the stupendous ice which surrounded us. Ultimately, after having been carried to and fro in the strait, the ship was beset, and we were helplessly fixed in the ice off a small island marked in the chart, upon which we afterwards bestowed the name of Princess Royal Island, and there we spent our first winter, in latitude of about $72\frac{1}{2}^{\circ}$. This terminated our first winter in the ice. When the navigable season returned in the following year we made another effort to get through the Strait, and failed. We then proceeded south again, rounded the point called Nelson's Head, which was the first land discovered, and proceeded along the western coast of the island which we afterwards called Baring Island. There, after encountering extreme difficulty and danger in our navigation through the ice along the western and north-western coast, we finally came into a bay called Mercy Bay, on the northern coast of Baring Island. We spent the second winter in that bay. We failed to liberate the ship during the following season, and we were reluctantly obliged to remain a third winter in the ship. We were never able to extricate ourselves, and we abandoned her in the following spring, by order of the senior officer, at Melville Island, with whom we had previously communicated, that is to say, he found records which we had deposited at Melville Island, in the spring of 1852, and which ultimately led to our rescue and safety, Captain Kellett having despatched at the earliest period of the year, a small party under the command of Lieutenant Bedford Pim, who, in the most gallant and persevering manner, brought us the cheering intelligence that succour was at hand, without which we should have perished to a man. Lieutenant Pim's party started with a temperature, which is, I believe, the lowest recorded for travelling. The fourth winter, after abandoning the ship, we proceeded across the ice in two divisions to the "Resolute" and the "Intrepid," and on our arrival at those ships in June, the officers and the crew of the "Investigator" were apportioned to each ship. We got through the winter comfortably, but failed to make any considerable distance, and the fourth winter was also spent in the ice. In the spring of the following year we were again detached from our winter position to the "North Star," and travelled to Beechy Island in April, the temperature, at starting, being 36° below zero and afterwards often lower, and returned to England in the autumn of 1854, after spending, continuously, four winters and five summers in the ice, having been absent from England nearly five years, and having discovered and made the North-west Passage, and circumnavigated the continent of America.

8932. (*Dr. Donnet.*) What was the complement of your ship on leaving England?—66, officers and men.

8933. Did you examine all these officers and men?—They were all carefully examined by myself or my assistant, but I saw all of them.

8934. What in your opinion should be the standard of age, of weight, and height of men for arctic service?—I stated everything very fully I think with reference to that in the instructions laid down by order of the Admiralty to the Arctic Committee (*delivering a paper to the Committee*).

8935. What amount of fresh food and fresh vegetables were you able to obtain on your voyage to the Sandwich Islands?—Very little indeed. As well as I

remember we obtained two small bullocks in the Straits of Magellan, but no vegetable food whatever.

8936. From the time of leaving England to the time of arriving at the Sandwich Islands were you not able to obtain any fresh vegetable food?—We got no fresh vegetable food whatever during that time.

8937. You say your first winter was passed in Prince of Wales' Strait; were you able to establish any communication with Melville Island during this first year?—No, we made no attempt to establish a communication. It could have been readily done, but we made no attempt.

8938. Had you done so, would you not have been made aware of the presence of Austin's expedition in the Polar Sea, and thus have anticipated your freedom from your icy prison?—After the travelling parties had been despatched to the north-west, north-east and south-east, I volunteered to go to Melville Island with five men, with the view of communicating with Captain Austin, who, we knew, was at that time, in the Polar Sea, so as to convey to him the intelligence of our position, and connect the two expeditions with each other. We had only five men available for the duty, the others having been despatched by Captain McClure, who did not adopt my suggestion, hence, to my great regret, no party was sent.

8939. Besides the winter spent in Prince of Wales' Strait, you mention having spent the two following winters of 1851-52, and 1852-53, in Mercy Bay; will you relate to the Committee the general mode of spending these last two winters, the precautions you took with regard to the men, the amount of exercise enforced, and other particulars which bear upon the maintenance of the health of the crew during those two winters in Mercy Bay?—The precautions I have also fully detailed elsewhere, but the exercise, as well as I remember, amounted to something like five and a-half or six hours daily. The crew were examined monthly, with the view of ascertaining their state of health, and to detect any early deterioration in it. The lime juice was most regularly issued. The provisions were very moderate in quantity, and the men's time was chiefly spent in hunting during the winter, reindeer having been seen some time after our arrival there, and we made the most strenuous efforts in the chase throughout the winter at the lowest temperature.

8940. Was not your ship warmed with the Sylvester stove?—Yes.

8941. Are you able to give the details of the system of warming by this apparatus?—The details are fully stated in my narrative of the North-west Passage. The Sylvester stove, as is well known, is an apparatus for disseminating warm air throughout all parts of the ship. Tubes communicated from the stoves to the officers' cabins, and opened into the captain's cabin, and also into the lower deck by means of perforations in the fore part of the tube; but in the captain's cabin aft it opened by means of a valve which could be opened or shut at pleasure, so as to regulate the heat. The tubes passing in the officers' cabins are also perforated with very small holes close to the stove, but with larger holes at a greater distance from the stove, and over that there is a grating through which the hot air escapes.

8942. Did this air communicate with the outer air; and was it cold fresh air brought in and warmed?—Cold fresh air was brought in and warmed.

8943. Then there was a communication with the outer air?—Yes, there was a communication with the outer air, as it found its way into the ship.

8944. You are acquainted, are you not, with the system adopted on board the "Alert" and "Discovery" for warming?—Yes, I have read an account of it.

8945. Do you believe it superior or inferior to that of the Sylvester stove apparatus?—I think I should have more confidence in the Sylvester stoves, so long as you can keep up a good supply of coal on which the whole warming of the ship depends; but that is always a great difficulty in Polar navigation.

Sir A. Armstrong, M.D.,
K.C.B.,
LL.D., F.R.S.
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21 Feb., 1877.

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8946. What amount of coal do you think would be required to keep up a proper system of warming and of ventilation with a Sylvester stove?—That is a question which I am unable to answer. Our supply in the first winter amounted, I think, to about 70 lbs.; but then it was only kept alight for a few hours during the day; but if you can keep a Sylvester stove lighted throughout the 24 hours, then I think it a very good system indeed of warming a ship with a larger supply of coal, in fact an unlimited supply of coal. In the second winter it was diminished, and I think it came down so low in the third winter that we only had 40 or 50 lbs. of coal a day. Each reduction took place from necessity.

8947. What routine was followed on board the "Investigator" with regard to the washing and bathing of the men; it is stated in evidence that the officers and men of the late expedition were divided into four divisions, and each division washed clothes once a month; was a similar system adopted by you?—I should say not. We had no regular system of washing; the men were not divided into parties in that way, but they got water occasionally; I should say not more frequently than once a fortnight, and the officers, I think, had a little tepid water about once a week. I am speaking, of course, from recollection, but I think it is pretty accurate, though it is a long time ago.

8948. Can you remember whether you found much difficulty in preserving the air of the living deck of the "Investigator" in a state of purity, so as to make it fitted for maintaining the men in good health?—It is a very difficult matter to preserve the atmosphere of the lower deck in these polar ships in a state of purity, in fact it cannot be kept in a state of absolute purity, but it may be made tolerably pure by the means which were adopted in the "Investigator," and, I assume, adopted in all other ships, that is, by having separate funnels opening through the housing, and carrying off the foul air in that way. The funnels were in good working order, and at night when the men were in their berths, you could see the funnels smoking like the steam pipes of an ordinary steamer, the rarified air rushing out in a white cloud just like steam.

8949. I know from experience the many difficulties that attend such experiments, but can you say approximately whether this air contained a larger proportion of carbonic acid gas than is considered good for breathing purposes?—I cannot say, but I should think it very probable. I never tested it; we had no means of testing it.

8950. It has been afforded to us in evidence that the air on the living deck of the "Alert," taken from level with the men's heads as they slept and at a point removed from direct in-drafts, was found to contain a percentage of .220 of carbonic acid gas; this experiment was made at midnight on the 23rd of October, 1875, before the ship was housed. Another experiment made on the 8th of November of the same year, under the same circumstances, and at the same time, but after housing, found the air charged with a percentage of .405; and when I add, upon the authority of the late Professor Parkes, that the carbonic acid should not exceed .6 per thousand volumes of air, would you say that the amount of carbonic acid gas found in the air of the living deck of the "Alert" exceeded that which was demanded for the maintenance of health?—The question is whether those experiments are reliable.

8951. They have been furnished as such to the Committee?—That would appear to be in excess, but I should fancy that, had we had an opportunity of judging in the "Investigator," matters would have been worse.

8952. Would you consider that the breathing of such an atmosphere as that described in the "Alert" would act in any way prejudicially upon the constitutions of the men?—It would have a deteriorating effect on the men's constitutions; anything that exhausts the vital powers and energies will deteriorate them.

8953. Can you inform the Committee whether any estimations of the amount of carbonic acid gas contained in the atmosphere of the ships of the Royal Navy have been made and submitted to you as Medical Director-General?—None.

8954. Was the dietary of the "Investigator" in any wise different from that of the "Alert" and "Discovery" which I now show you (*handing a paper to the witness*)?—Very different. The quantity of meat was three-quarters of a pound; the vegetables, which were only of two kinds, potatoes and carrots, were also less, and the diet in all other respects regarding the issue of antiscorbutic articles of food was very much inferior.

8955. Do you consider this dietary an ample one for the preservation of the men's health?—I do not consider it so for any length of time in the Polar Sea. I think it should have been a larger dietary, and differently cast altogether, more in accordance with the recommendation which I made to the Admiralty for the expedition.

8956. It has been admitted in evidence that the 2 lbs. of meat which you refer to in your suggestions and recommendation, proved too much for the men, and that the quantity could not be consumed?—The 2 lbs. of meat probably require some explanation, inasmuch as when I laid down that scale I judged of the character of the meat that we were supplied with in the "Investigator," whereby I think that the 2 lbs. there as issued would not probably amount to more than to 1 lb. 8 or 10 oz., making allowance according to our computation at the time for the bone in the salt meat, and the jelly in the preserved meat, so that of actual food I doubt if there would have been more. There might have been less, but on this occasion, with from 1 lb. 8 oz. to 1 lb. 10 oz., apportioned in the way that I assumed it would have been in accordance with my recommendation, it would have enabled each man to have a little meat at breakfast, and a little at dinner, and a little at supper, which, certainly for the maintenance of health for any length of time in the polar regions, is an absolute necessity. The meat should not be issued, of course, all at once; but if with a careful system of issue it was placed before the men, I entertain no doubt whatever that they would eat it: but it does not appear to me, so far as I have seen, that that system of issue was adopted. It is in evidence that some of the sledge parties ate $1\frac{1}{2}$ lbs. meat when they got it, and on the voyage home ate 2 lbs. of seal meat as a ration.

8957. The weight of evidence given was strongly against the salt meat supplied as part of the dietary; it was considered hard, tough, and very salt. I would ask whether you consider salt meat to be a predisposing cause of scurvy and whether a continuance of this diet, under certain conditions, would induce this disease at a much earlier period than when the diet has consisted of fresh meat?—Salt meat is not so nutritious as fresh meat, and certainly food of an innutritious character would be more likely to predispose to scurvy than that which is more nutritious.

8958. But it would not of itself produce scurvy?—Not with a suitable allowance of vegetable food.

8959. In the absence of the constituent of food which is afforded by fresh succulent vegetables, would salt meat assist more readily in inducing scurvy?—Yes, the absence of vegetable food of itself would cause scurvy.

8960. Will not a crew living for a long period upon salt meat more readily fall victims to scurvy, although they have vegetable food in combination?—Yes, they would.

8961. Have you any suggestions to make with regard to a better method of curing or preserving beef for arctic purposes?—I mentioned also in my instructions for the Arctic Committee, that the meat should be preserved for that purpose with the least possible degree of salt, and I suggested that other condiments might, in all probability, in the present day, be found equally preservative of meat instead of

salt; that will be found in my Memorandum to the Arctic Committee, which I assumed would have been adopted.

8962. Has it come within your knowledge that beef can be preserved in sugar, and that when thus cured it retains its nutritious qualities?—I have heard so, but I have had no experience of it.

8963. Among the many cases of scurvy which fell under your observation during your exceptional position as surgeon of the "Investigator," did you consider that the cold to which the men were exposed had much or any influence towards predisposing to scurvy?—Cold, or any other agent that lowers the vital powers, predisposes to disease, and leads to the deterioration of health.

8964. You would therefore consider that cold acts as a predisposing cause simply by the power it possesses of lowering the system?—Yes.

8965. What cold did you experience?—The lowest degree of cold which we experienced was 67° below zero.

8966. For what period of time was that degree of cold observed?—It was observed in January, 1853, I think; the mean temperature upon one day was $61\frac{1}{2}^{\circ}$ below zero for the twenty-four hours, and the mean temperature for the whole month, as well as I remember, was $43\frac{1}{2}^{\circ}$.

8967. The amount of exercise taken by the men of the late expedition during the winter months, as stated in evidence, was five and a half hours per day, of which three and a half were taken before dinner, and two hours after; this amount, you will admit, was sufficient to maintain the health of the men in winter quarters, was it not?—Yes.

8968. Knowing, as your experience must have taught you, the importance which a proper system of exercise confers, are you of opinion that this amount of training in the late expedition was sufficient so as to render the men more fitted for the excessive work they were about to have in the spring?—This exercise would have kept them in health during the winter, but I think that a little sledge exercise for short distances, probably in the spring, would have been desirable; but I cannot discover in any papers which the Committee have been good enough to place before me, that the full amount of exercise, as recommended, was taken.

8969. In order to assist you in forming a judgment upon the point, I now furnish you with abstracts from the logs of the two ships, showing on what occasions they had them out for exercise; and to a certain extent, for what time (*handing the same to witness*)?—The only thing, I would remark about this paper is, that the exercise as here noted is almost an exceptional thing, and not continuous; whereas if the exercise had been fairly laid down and inculcated as a daily order, there would have been no necessity for putting it in the log; but you will find here at intervals, days where the exercise is not noted, and it might be assumed from this paper that the exercise was not taken on those days, and that the system of exercise was not regularly carried out as recommended.

8970. Were your men in the "Investigator" exercised in any special manner of training?—The regularity with which the daily exercise was taken, and the efforts which they made in the chase, afforded ample exercise for any body of men on such a small allowance of food as they had.

8971. Did any of your men overtax their physical strength by this mode of training?—Frequently they did.

8972. What were the bad effects which followed this overwork?—General fatigue for a time, from which they speedily recovered after rest, as in the case of any undue exertion under ordinary circumstances.

8973. In your mode of sledge travelling, did you adopt any particular system?—In the early journeys I think that the system of ten hours travelling was adopted, but in the later journeys a system of six hours travelling and six hours rest alternately was

adopted. In the spring of 1852, when Captain McClure went from the "Investigator" to Melville Island, from the great difficulties which he experienced in meeting with heavily packed ice, he was about to relinquish the attempt when he adopted the system, with the view of recruiting the men, of travelling six hours and resting six hours; and that was the course which was adopted by all subsequent parties from the "Investigator," and which I think was a judicious one under the circumstances in which we were placed, and, I may add, in polar travelling as a rule.

8974. Considering the work which was gone through by the sledging parties of the late expedition, could you establish any comparison between the amount of work done by them and that done by any of the sledging parties of the "Investigator"?—I think that the work done by the sledging parties of the late expedition was very severe indeed and excessive; greater probably than that which was generally encountered in the "Investigator."

8975. Before the outbreak of scurvy on board the "Investigator," had the men in that ship work in anywise equal to that undergone by the men of the "Alert" and the "Discovery"?—It was a different kind of work, it was hunting, which was not of such a severe character as the work gone through by the spring sledging parties of the late expedition; but was of much longer duration, extending over years.

8976. Were you at that time supplied with fresh meat, such as musk-ox beef, reindeer, hares, &c.?—Occasionally.

8977. Was their dietary much varied by this supply of fresh meat?—The issue of fresh meat entirely depended upon the supply, sometimes we would get a pound of fresh meat once a-week, and occasionally three times a fortnight, for a period as long as the supply continued.

8978. Will you furnish the Committee with the details of the dietary of the "Investigator," or can you afford to the Committee a scale of this dietary, and the changes made during the whole commission of the ship?—I will furnish a table.

8979. It is reported in evidence that the men, after the winter months—when examined by the medical officer—were found to be in a satisfactory state of health; considering the many lowering influences to which they had been exposed during that period of darkness, do you suppose that they were as well fitted at that time for the hard work that they were about to undertake, as they were before the winter had set in?—There is no evidence to prove that they were not, but everything to the contrary. They proved to have been so by the report.

8980. Would you not say that the pallor and blanched appearance of the men, to which so much of the evidence alludes, was an indication of a deteriorated state of the blood, a degree of anæmia, and a deficiency of the red globules in the blood?—That appearance is incidental to all men in the polar service after the winter.

8981. Would you consider this pallor and blanched appearance an incipient sign of a scorbutic taint?—No; otherwise we ought to have had scurvy during the first year in the "Investigator," and most assuredly so in the second winter, but we did not have it.

8982. Would not this appearance lead you to suppose that the men were not in that vigorous condition of health in which they should be?—I think that a man's health undergoes a certain amount of deterioration during the winter, but which, under good diet and the free use of antiscorbutics, readily disappears in the spring; but there was no evidence that they were less vigorous.

8983. In the course of this inquiry, several of the witnesses have stated that the seeds of disease were sown during the long winter months; although the language is not scientific, as scurvy is not propagated by germs, was not there some foundation for using this phrase in the pallor and blanched appearance of

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the men?—I cannot attach any importance to that whatever.

8984. Had men been transported at once on the floe, having passed the winter months under more favourable circumstances, say men brought at once from England, would they not have been in better condition to undertake the work of the spring?—I doubt it, so long as the men were well fed, well clothed, and a hygienic system strictly carried out as recommended, and as far as it can be carried out in the Polar Sea.

8985. Do you think that the absence of light has any influence upon the human system?—I think it has.

8986. In the instance, for example, of miners, glass blowers, and printers, whose duties are done by night, and who are consequently deprived of the beneficial influence of light, do you not observe that these men are not in a vigorous state of health?—The nature of their occupation necessarily renders them so; but other circumstances must also be taken into consideration, the habitation and the mode of life. Amongst these men a large amount of squalor and disease exists, and they inhale bad air, and it ought not to be attributed to the absence of light, but to numerous other causes.

8987. Am I right, then, in inferring that you attach no influence to the absence of the sun's rays on the human constitution?—No; I consider it exercises a certain influence in combination with other causes.

8988. It has been stated in evidence, that a ship's crew started on a voyage will, if deprived altogether of fresh vegetables or milk, become more or less scorbutic within about six weeks. I would ask you, had this same ship's crew been placed under circumstances similar to those of the arctic sledge parties, would not the depressing influence of the arctic seas have assisted in developing the disease amongst these men at a much earlier period than six weeks?—Yes, if deprived of vegetable food.

8989. I am anxious to know from you whether the development of scurvy may not be hastened when other causes are in action at the same time with the cause which you mentioned, namely, the absence of vegetable food, which produces scurvy?—Yes.

8990. From your observations, do you think that lime juice loses any of its properties by keeping?—No. The lime juice found in Polaris Bay furnishes strong evidence on that point.

8991. If once frozen, will it lose its therapeutical action?—No. The lime juice found in Polaris Bay furnishes strong evidence on that point.

8992. Was the lime juice supplied to you as good the third winter as it was the first?—Yes.

8993. Then you are of opinion that lime juice may be kept for some time, and may undergo the process of freezing, without losing its antiscorbutic properties?—Yes.

8994. Do you look upon lime juice as the best substitute we possess in the absence of fresh vegetable food?—Undoubtedly.

8995. Do you believe that it possesses all the required properties to render a body of men immune from an attack of scurvy?—Yes.

8996. Is lime juice, in your opinion, as good as fresh vegetables?—It is the best substitute when fresh vegetables cannot be procured.

8997. Would you not consider it as an efficacious substitute?—As a substitute. There is nothing so efficacious as fresh fruit and vegetables, more so in the uncooked state.

8998. Have you formed any opinion upon the relative qualities of antiscorbutics?—Yes.

8999. And to which of them do you give the superiority?—To lime juice the first place; the next is citric acid, but I consider the antiscorbutic properties of citric acid feeble.

9000. Do you consider citric acid to possess antiscorbutic properties sufficient to prevent an outbreak of scurvy?—I do not think it would, and I should be very sorry to trust it.

9001. You would not take the responsibility upon yourself to supply a sledge party with it for that purpose?—On no account whatever.

9002. Evidence has been given of the very large amount of fresh meat consumed by one man in the 24 hours, a diet exclusively flesh without any admixture of fresh vegetable food. May I ask whether you believe that something is to be found in animal food which acts upon the blood in the same way as does fresh vegetable food?—I think it probable that in the large quantity of animal food to which you allude, particularly if taken in the raw state, or in a state partially cooked, there may be, and there probably is, in the juices some combination of the vegetable acids, lactic, I presume, chiefly, that may have the effect of warding off scurvy, but which would not exist in the meat fully cooked.

9003. Dr. Rae, in his evidence, stated that the allowance for a man was 8 lbs. of fresh meat per day, and he further observed that, "when you have no vegetable food or no bread, there is something that the system wants which is in very small quantity in animal food, and therefore you have to eat a very great deal more than you want in order to get at this quantity from the meat"; do you think so?—I am not at all disposed to question that opinion; I think it is very probable, knowing, as we do, that there is a considerable amount of lactic and phosphoric acid in raw meat when analysed, which may account for the antiscorbutic properties which in this large quantity it is supposed to possess.

9004. It is related by Captain Cochrane, in his journey through Russia and Siberia, that the Yakuti and Tongousi consume enormous quantities in one day. He says: "I have repeatedly seen a Yakuti or a Tongousi devour 40 lbs. of meat in a day. I have seen three of these gluttons consume a reindeer at one meal; nor are they nice as to the choice of parts, nothing being lost, not even the contents of the bowels, which, with the aid of fat and blood, are converted into black puddings." This great amount of meat must supplement the vegetable food wanting?—That case is so exceptional, that I think the author would be most competent to give a reply to any question about it.

9005. In the sledging parties which left the "Investigator" for the purpose of searching, did lime juice form part of the ration of the men?—In the first sledging parties it did not, but in subsequent parties it did. I represented to Captain McClure the necessity of taking lime juice with the parties who were only to be absent forty days. He entertained a very high opinion of the efficacy of lime juice, and was desirous of husbanding it as much as possible, and he declined to send it with the sledge parties. Finding that, I sent a proportionate quantity of citric acid for their use, although very doubtful of its efficacy.

9006. How was the citric acid sent?—Crystallized.

9007. Do you know how the men took it?—I do not know; directions were given for its use, in water or rum.

9008. Are you aware of the difficulties which attend the thawing of a substance like frozen lime juice in a temperature such as the sledge parties in the late arctic expedition suffered from, the thermometer in some of the sledge parties indicating a temperature of -42° . Would not much fuel be required to reduce this frozen matter to a liquid state, and would not a somewhat similar amount of fuel be required to liquify a proportionate amount of water?—I could not admit the existence of any difficulty in a question of such vital importance to the health and safety of the parties, sufficient to prevent lime juice being used; and it might very readily, in my opinion, have been used either with a ration of rum or in the tea, or what I think is still better, in the pemmican itself, as we know that lemon slices are very extensively used in cookery, particularly in such forms of food as minces and hashes, which very closely resemble pemmican, and I believe that if the lime juice were so added to the pemmican when the mess was made, it would

render the pemmican much more palatable, the men would take to it more readily, and it would aid very materially the assimilative process of digestion, and thus, in my opinion, would enable them to eat their full allowance, or even more if they could get it.

9009. Do you think it would have assisted them in assimilating the food more readily?—I do, certainly.

9010. The Jews, we are told, possess a greater immunity against epidemic diseases, cholera, yellow fever, &c. Do you think this immunity is due to the quality of their food, and to the greater quantity of vegetable acids, which it is said is usually taken by them?—If such be the case, I have no doubt that it would be due to that.

9011. What is your opinion of rum as a ration on sledge parties?—I think rum should not be considered as a necessity in sledging; but I am quite free to admit that a little rum, a small quantity, after the fatigue of the day is over, can hardly be considered objectionable, as it adds very much to the comfort of the men; but at no other time, nor more frequently, would I at all recommend it.

9012. Some of the evidence afforded was in favour of tea at lunch-time, if it could be readily procured, but that rum was taken, owing to the less time it took in preparing?—Men never work so well after taking rum in the middle of the day; tea is infinitely preferable.

9013. It was not that they preferred rum to tea; it was that the making of the latter required a greater amount of time and a longer halt. In evidence it was stated that it took thirty minutes to prepare the rum and an hour and a half to prepare the tea?—I think those long halts in travelling are very injurious to the men. It would be much better were they to encamp and rest for four or six hours and then proceed again, and let them have a comfortable meal after six hours' travelling.

9014. Many of the witnesses did confess that the halts did cause much inconvenience to them?—I have no doubt of that.

9015. Assuming that lime juice is to be carried in sledge parties, what quantity would you recommend to be taken?—I think an ounce to men in health would meet all requirements; no less than that.

9016. This with sugar would amount to about one pound a day for an eight-man sledge, and say that the sledge was provisioned for 80 days, it would necessitate an addition of 80lbs at first starting, would it not?—I think the sugar might readily be dispensed with if lime juice is used in what I consider the best way of using it under such circumstances, that would be in the mess of pemmican; or other articles less vital in importance than lime juice might be dispensed with rather than that it should not be taken; a proportionate weight of other articles, I mean.

9017. The acknowledged arctic sledge weight is stated to be 240 lbs. per man. This seems a very heavy weight for a man to drag across a floe so difficult as that described and for the time prescribed. Would you say that if sledging be again undertaken the length of the journey should be curtailed, so that the amount of the provision would be less and the addition of lime juice and extra fuel would not even then reach these very heavy weights?—Yes; most certainly I consider those weights excessive, and rendered more so by the nature of the work the men had to go through.

9018. It has been stated in evidence that lime juice, in the absence of other forms of vegetable food, will prevent the occurrence of scurvy under circumstances where scurvy would have occurred without the addition of lime juice to the dietary; does your opinion coincide with this?—Undoubtedly.

9019. Assuming this to be the case, are you of opinion that lime juice would have modified in any way the conditions under which the sledge parties laboured?—It would have prevented the outbreak of scurvy, and of course have rendered the men less liable to suffer from other causes.

9020. Would it therefore, in your opinion, have prevented the process which eventually terminated in the deterioration of the blood, which in these men, and under the conditions in which they were placed, eventually declared itself as scurvy?—Yes.

9021. Have we not had instances where men have been away sledging for upwards of three months, 105 days in one instance, upon a diet less generous than the one supplied to the late sledging parties, without lime juice, or, I may say, any antiscorbutic, and yet have returned to their ship without any symptom of scurvy. I allude especially to Sir Leopold M'Clintock's journey in 1853, when he was away 105 days, performed 1230 miles, and had no lime juice?—I am aware of the circumstance; but it must be considered that during that time Sir Leopold M'Clintock procured a very large amount of fresh food; that, as I believe, his travelling was very judiciously managed; that the men's physical powers were never overtaxed, and no exhaustion ever produced, hence the physical powers of the men did not deteriorate, recruited as they were from day to day with fresh food; and, so far as I can understand it, they had at the same time a fair allowance of vegetable food in the form of, I think, preserved potatoes. But there is no evidence that these men may not have returned with mild symptoms of scurvy, not sufficient to attract the notice either of the officer in command of the sledge, or even of the men themselves, whose return to the ship always ensured them rest and an improved dietary which would cause, probably, a subsidence of these early symptoms of scurvy. I will now hand in a paper, compiled from the records of my department, more fully setting forth the reasons for the view which I have just expressed, and from which it will be seen that one of the men who had been travelling with Sir Leopold M'Clintock for 106 days died soon afterwards (Appendix, No. 30). His case was reported as one of hepatitis, but the surgeon records in his journal that this man had symptoms of scurvy. Another case, which also proved fatal, is entered as bronchitis; but from personal knowledge of it, having seen the man, I know it was a case of scurvy. This man also had been travelling during this and the previous year.

9022. We have had it in evidence that, one month prior to the departure of the sledging parties of the "Alert" and "Discovery," the allowance of lime juice was doubled. Would you say that by increasing the allowance, and by saturating the system, a greater power of resistance would have been afforded to the men about to be exposed to severe arctic conditions?—I can see no necessity for it whatever; and I do not understand what the system being "saturated" with lime juice means. I consider one ounce of lime juice ample, as long as men are free from symptoms of scurvy. It should be observed that this additional allowance was issued by the captain without reference to the fleet surgeon and was left optional with the men.

9023. Would men have become tolerant of this quantity, and have consequently required a greater amount to protect them from severer influences?—I attach no importance to that.

9024. Do you think that lime juice, by habit, loses its prophylactic power?—No. I would not increase the quantity of lime juice beyond one ounce as a prophylactic. It would be necessary to increase it, of course, if men get scurvy to a larger extent according to circumstances.

9025. At what period did you observe a falling off of the health of your ship's company in the "Investigator," and were there any special conditions which attended this failure of health?—After the second winter we became sensibly affected when the provisions had been reduced.

9026. When did scurvy break out on board the "Investigator"?—In the spring of 1853.

9027. Were you able at the time to give fresh meat to your men?—Yes, all had it occasionally.

9028. What amount of lime juice was then issued

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to each man?—It depended upon circumstances and the requirements of each case.

9029. Had you no symptoms of scurvy during the first year whilst in the Prince of Wales' Strait?—None.

9030. None during the second?—None until we were affected by the reduction of provisions.

9031. Had you many cases of scurvy?—I am not quite sure that any of the ship's company were free from it when we abandoned her.

9032. Had you any deaths from scurvy?—Three on board the "Investigator," all within one week in the spring of 1853, when we were suffering greatly from want of food.

9033. Had you any deaths from scurvy after abandoning the "Investigator"?—I think two deaths afterwards might be traceable to the effects of scurvy, and probably a third, which was a case of phthisis in an officer, was more or less affected by it.

9034. Were you able to obtain scurvy-grass or sorrel?—In one summer, the summer of 1852; not much scurvy-grass, but sorrel we got for a short time in considerable quantities.

9035. Did you cook the sorrel or was it eaten raw?—As a rule we generally preferred making it in the form of salad with mustard and vinegar; some had it cooked.

9036. I believe you had a coloured man among those who fell ill of scurvy?—We had a Canadian, he was coloured.

9037. Was the disease as easily recognised in him as in a white man?—Yes.

9038. Did you find any difference in the symptoms?—No.

9039. You think, then, that scurvy is a disease which has no respect for race or colour?—Yes.

9040. Do you know whether the Esquimaux suffer from scurvy?—I believe they do.

9041. May I ask, whether any suggestions and recommendations were given by you to the medical officers of the arctic expedition?—The Admiralty called on me to draw up suggestions and recommendations for the information of the commanding and medical officers of the expedition. I did so, and forwarded them to the Admiralty, and by the Admiralty they were forwarded to the commanding officers of the "Alert" and the "Discovery," and these suggestions and recommendations, I find, are alluded to in the sailing orders to the captain of the "Alert," hence I assume that they partook rather of the character of orders than of suggestions and recommendations. Otherwise I do not see why the Admiralty would have called on me to draw them up, had they not intended them to have been strictly followed, or why they were embodied in the sailing orders if it was not intended that they should be considered as orders and so acted on.

9042. In the medical instructions supplied to the officers commanding the sledge parties, which I now show you (*handing them to the witness*), reference is made to scorbutic symptoms under the head of "rheumatic pains," "spitting of blood," "swollen legs and ankles," and the concluding words of Dr. Colan's instructions are, "Officers should make themselves well acquainted with scurvy-grass and sorrel, in order to make use of them as antiscorbutics if met with." Were the references to this disease, in your opinion, sufficiently explicit?—I assume that some verbal instructions must have been given regarding scurvy before these instructions were issued.

9043. I find in the evidence that Dr. Ninnis called Captain Stephenson's attention to the case of John Shepherd, and told him that "it was of the utmost importance that all the officers should see this man's state, and see what scurvy was in case of its breaking out." I likewise find, from the evidence afforded to the Committee, that Dr. Colan told Captain Markham that "if scurvy broke out, he had better give the men as much onion powder and potato as he could, and that when a man complained of internal pains, and occasional spitting of blood, he would be

good for nothing, but to be taken great care of and given as much food as possible, and that that man had probably scurvy." Should not this allusion to scurvy, with these remarks have been embodied in the instructions afforded to the commanders of the sledges, instead of being verbally given?—I think it would have been desirable if they had been; but, I would add, that it would have been equally desirable for the commander of the expedition to have given the commanding officers of sledges instructions whether to proceed or return, in the event of scurvy being recognised, which at least would have spared many disasters which subsequently occurred, although they were unprovided with any agent that could arrest its progress.

9044. (*Dr. Fraser.*) May I ask you, what was the intention of the medical officers of the expedition in issuing these medical instructions to the sledge parties?—With a view of maintaining the men in a state of health and efficiency.

9045. It strikes me that they were probably instructions designed to meet emergencies and to suggest the most ready means of treating those medical or surgical emergencies at the command of the sledge parties; is that so?—Certainly.

9046. I believe you have had a large number of papers connected with the recent expedition laid before you?—Yes; I have had all the evidence.

9047. And you are aware, of course, that among the substances carried by the sledge parties, lime juice was not included?—Yes.

9048. You have been asked whether these instructions should have contained more ample details in reference to the symptoms of scurvy. Do you think that these details would have been of any practical value in the absence of what you have already told us is the only valuable remedy for scurvy?—I think they would have been so far valuable that they would have made the officers in command of the sledge parties more certain than they appear to have been with regard to the symptoms of scurvy when they appeared.

9049. And in what respect would that bear upon what I apprehend is the purpose of the instructions, the treatment of ordinary slight casualties and illnesses, including perhaps scurvy?—They could not have treated scurvy, because they had not the means of doing so.

9050. They would have supplied them with information, merely?—And if that information had been supplemented by such orders as I have already alluded to, by the commander of the expedition, it would have enabled them to act on the information as to whether they proceeded on the journey or returned, although unable, as I said before, to treat the disease.

9051. These instructions do not appear to be dated, but I apprehend that they were probably prepared and issued immediately previously to the starting of the sledge parties?—I think so.

9052. We have it in evidence that at that time the chief medical officer of each ship had expressed his opinion to his commanding officer of the great importance of carrying lime juice in the sledge expeditions, with a result with which we are also acquainted. As lime juice was not to be carried, do you think it at all wonderful that the symptoms of scurvy were not entered into with more detail in these instructions than they have been?—I think it not at all surprising that they were not, inasmuch as they were deprived of the only remedy which could have been of any avail in treating it.

9053. In fact, the instructions would be merely encumbered, I apprehend, by any detailed description of the symptoms of scurvy, when the practical object of such detail could not be effected?—If the occurrence of scurvy had been apprehended, it would certainly have been desirable for the officer in command of the sledge to know when it occurred.

9054. But I imagine that the only means of communicating that knowledge, or probably even the best means of communicating that knowledge, was not in the restricted space which must necessarily be

found in such instructions as we are now discussing?—Such instructions would not occupy great space; but I assume that as scurvy had formed the subject of conversation, I believe frequently, it is hard to suppose that its general appearances were not known.

9055. If the purport of the instructions is to assist in the treatment of any medical or surgical emergency, including scurvy, and if the appropriate remedy for that emergency be absent, do you think that the medical officers who drew up the instructions could well have done more than point to such remedies as might be found, as I observe Dr. Colan has done where he asks the officers to make themselves well acquainted with scurvy-grass and sorrel, in order to make use of them as antiscorbutics?—I think I have already answered that in a former answer; otherwise I do not think that the subject of sorrel and

scurvy-grass would have formed part of those instructions had verbal instructions regarding scurvy not been previously given; but I think it would have been highly desirable if there had been free communication and interchange of opinions between the commander of the expedition and the principal medical officer, with regard to what is most suitable for sledge travelling, with a view of preventing the occurrence of that which so unhappily appeared, scurvy, bearing in mind how strongly the use of lime juice was inculcated in my recommendations on the subject, and which the Admiralty considered of sufficient importance to include in their "Sailing Orders" to the captain of the "Alert," and consequently, in my opinion, the memorandum thus became an order.

9056. You refer to the suggestions and recommendations dated 30th of April, 1875, I presume?—Yes.

The witness withdrew.

Adjourned to to-morrow at 12 o'clock.

THURSDAY, 22ND FEBRUARY, 1877.

PRESENT:

ADMIRAL SIR JAMES HOPE, G.C.B., in the Chair.

ADMIRAL SIR R. COLLINSON, K.C.B.

VICE-ADMIRAL E. A. INGLEFIELD, C.B., F.R.S.

JAMES J. L. DONNET, Esq., M.D., Inspector-General of Hospitals and Fleets, R.N.

THOMAS R. FRASER, Esq., M.D., F.R.S.E.

H. J. VANSITTART NEALE, Esq., Secretary.

SIR ALEXANDER ARMSTRONG, M.D., K.C.B., LL.D., F.R.S., *further examined.*

9057. (*Dr. Fraser.*) Am I right in understanding you to say that the suggestions and recommendations dated the 30th of April, 1875, were prepared by you at the invitation of the Lords of the Admiralty?—Yes.

9058. The second paragraph, I believe, refers to the selection of the crews, on which you had given your views, I think?—Yes, in a memorandum to the Arctic Committee, drawn up by order of the Board.

9059. That paragraph, along with the paragraphs from No. 3 to No. 8, expresses your opinion as to the best methods of maintaining the health of the men on board ship?—Yes, in the arctic service.

9060. You have, I believe, seen the papers, as well as the evidence which has been brought before this Committee; and from your perusal of those papers and that evidence, is it your opinion, generally speaking, that these suggestions were fairly carried out; or have you any further observations to offer to the Committee upon that subject?—I do not find in the evidence that the suggestions which I made with regard to diet have been carried out.

9061. Can you give us some further details as to any respects in which you think it was important that your suggestions with regard to diet should have been carried out, but in which, so far as you know, they have not been carried out?—The quantity of the meat which I recommended to be given does not appear to have been given, nor do my recommendations as to the mode of giving it appear to have been carried out. I would remark, in reference to the two pounds of meat which I recommended, that that does not represent actually two pounds of meat; but making due allowance for the bone in the salt meat, and the jelly in the fresh meat, I do not estimate it at more than from 1 lb. 8 oz. to 1 lb. 10 oz. of actual meat; also, I do not find that the meat was given at breakfast and supper, as I recommended. With regard to paragraph 5, I do not find that the amount of exercise recommended was carried out, so far as I can glean from the evidence and the papers furnished to me, as I find there were only two hours of compulsory ex-

ercise during the day; and the notations made in the log would appear to show that even that was not compulsory, and that exercise is simply noted as an exception, days intervening when there was no record of its having been taken. I rather fancy that all the recommendations in the other paragraphs have been generally carried out until I come to paragraph 11.

9062. Paragraph 7, I think, refers to ventilation?—Yes.

9063. Have you had the papers laid before you showing the results of examinations of the air on deck in both ships?—I have.

9064. Is it your opinion, judging simply from those papers, that the air was sufficiently pure?—It is impossible to consider that the air between decks of any arctic ship during the winter can really be pure, and it is equally impossible to make it so.

9065. Then I may infer that your opinion is that the air was not pure?—My opinion is that the air between decks of no arctic ship can be pure, and it certainly was not pure in this case; but, I should say, perhaps less impure than in the ship in which I served.

9066. I do not know whether you have been struck with a discrepancy in the statement of the carbonic acid estimations in the "Alert," as distinguished from the "Discovery," in the air outside of the ship?—I am aware that there has been a discrepancy.

9067. And a most striking discrepancy?—Yes.

9068. Do you think that the method of analysis, under the special difficulties which would attend analysis in the conditions in which these ships were placed, might, to some extent, account for that discrepancy?—I certainly think so.

9069. You are aware probably that the estimations of the carbonic acid outside the ship made by the medical officers of the "Alert" coincide generally with previous estimations, whereas those made by the medical officers connected with the "Discovery" show an enormous excess of carbonic acid; is it not probable, therefore, that the discrepancy is due to errors

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connected with the latter estimations?—I should think it probable.

9070. You yesterday referred to the advantages of the Sylvester stove, and gave us a description of that stove. I did not quite gather, however, from your description, where the air that enters the tube or tubes of the Sylvester stove is obtained from?—To the best of my recollection, it is obtained from the outside air. But I fancy that you will find a fuller description than I can give you in the appendix to my narrative.

9071. So far as you can recollect, the tubes in connection with the Sylvester stove had not a direct opening into the outer air?—No.

9072. Why do you think it impossible to keep the air pure in arctic ships?—You cannot get in a sufficiency of fresh air, to promote the escape of foul air with sufficient rapidity to render the ship habitable.

9073. Is the great obstacle the low temperature?—Yes, the low temperature is the great obstacle.

9074. If the air were heated previously to its distribution between decks, could not a greater change be effected than when the air is admitted at the very low temperature which necessarily exists?—No doubt; but then you must give all ships a much larger quantity of fuel, and in all probability render the ships totally unfit for that particular service by so doing. The whole question hangs on the one of fuel, and the capacity of the ship to carry it.

9075. The fuel expended in heating this air is not, however, lost, I imagine, because the heated air itself becomes a means of raising the temperature, and probably a more effectual means than mere radiation from the stove or from the heated pipes; do you not think so?—It might be; but notwithstanding that, it would still require a larger amount of fuel to be carried than any ships suitable for arctic service could possibly carry.

9076. But if the amount of fuel required for such an arrangement does not require necessarily to be increased, is it your opinion that such an arrangement would be a good one?—It is my opinion that an arrangement whereby you could promote the entrance of hot air would be very desirable, if it could be carried out.

9077. I think that from paragraph 9, you give your views respecting the treatment of the men during sledging?—The examination of the men before and after.

9078. In paragraph 10, you advise that a small supply of such surgical appliances and medicines as might be considered by the senior medical officer of the ship suitable for meeting ordinary slight casualties and illness, with clear and well defined instructions for use, should be placed in charge of the officer commanding the party?—I have so recommended it in this paragraph.

9079. Can you tell us whether the printed instructions, which have been before the Committee, prepared by the senior medical officers of each ship, fully comply with this recommendation; and if they do not, in what respects they fail to do so?—So far as I can judge from the evidence, and from the instructions, they appear to have been fully carried out certainly. The list of articles sent from the "Alert" appears to have been more complete than those from the "Discovery," and I observe that no splints were sent from the "Discovery"; but, generally speaking, I fancy that they were quite equal in both cases to meet the emergencies for which they were intended.

9080. And are you equally satisfied with the instructions being clear, and well defined, and sufficient?—Quite so.

9081. Both the supply of surgical appliances and medicines, and the instructions were designed to meet ordinary slight casualties and illnesses?—Yes; every casualty that might reasonably be expected to occur in sledging.

9082. In paragraphs 12, 13, 14, and 15, and I think also 18, you refer, further, to slight ailments and accidents to which you have thought it proper to

direct special attention?—Yes; and all those appear to have been carried out so far as I can judge. Of course, I have had no opportunity of forming an opinion, but I assume that they were.

9083. In the recommendations contained in paragraph 16, you also, I think, provide for the occurrence of slight casualties and illnesses by recommending a supply of the Medical and Surgical Hand Book?—Yes; I was anxious that, in addition to any instructions that might be issued by the medical officers of the ships in the polar regions, the commanding officer of the sledge should also have a small book published in my department for the guidance of commanding officers of small gun boats in which there are no medical officers, and which, I thought they would probably more clearly understand, and might embrace some points which might not occur to the surgeon in giving his instructions; and hence I understand a copy of this small book was issued to each officer in command of a sledge, so far as I can learn.

9084. I observe that you have not in these suggestions and recommendations (paragraphs 11 and 17), omitted to refer to scurvy as a possible contingency during sledging?—No, I have not neglected to do so; I did refer to the possibility of scurvy in the inspections, and perhaps I may supplement to that an explanation with regard to paragraph 17. It will be seen by the Committee, that in paragraph 17 a copy of my book "On Naval Hygiene and Scurvy" was also supplied to each ship, with the view that the commanding officers, the medical officers, and the officers who might be placed in command of sledges, should fully understand everything pertaining to scurvy in its very earliest stage, and this book, I assume, must have been read by those officers for whose information it was intended.

9085. In paragraph 11, you recommend that lime juice should be used when travelling in the same manner as on board ship; why did you attach so much importance to the use of lime juice?—From my previous experience of its great and undoubted efficacy in the "Investigator."

9086. You attach so much importance to it as the result of very considerable experience, I believe?—Yes.

9087. Does that experience coincide generally with the opinion of a large number, at any rate, of medical authorities?—It coincides with the opinion of all the medical authorities that I know anything about.

9088. Are your views with reference to the value of lime juice as an antiscorbutic incorporated in the work referred to in paragraph 17?—Yes.

9089. Although in some of the paragraphs to which I have referred you have mentioned certain special illnesses and accidents that may occur, I observe that, with the exceptions to which we have referred, that is to say paragraphs 11 and 17, you do not refer to scurvy as a probable accident, nor do you enjoin the chief medical officer of each ship to include a description of scurvy in the directions which they are requested to give to the sledging parties; is this because you anticipated that if the recommendation contained in paragraph 11 was strictly carried into effect, scurvy, in all probability, would not have occurred; or is there any other reason why you have not done so?—It was entirely due to my strong belief that the recommendations made in paragraph 11 would have been fully carried out.

9090. And if they had been fully carried out, do you anticipate that scurvy would not have occurred?—I do not think that scurvy would have occurred.

9091. In your experience in arctic regions, have you had occasion to know that lime juice may be carried by sledging parties?—Yes.

9092. And when the temperature is very low?—I have not had experience in carrying lime juice when the temperature was very low, but I should have no hesitation whatever in stating that lime juice may be carried without inconvenience, and used also when the temperature is very low, as low as has been recorded.

9093. You know the circumstances, I have no doubt, of the sledging parties of the recent expeditions, can you offer any opinion as to how lime juice could have been carried and used by them?—It appears to me that lime juice might have been carried very much in the same way as rum was carried, that is to say, in small wooden breakers, made light and portable, probably with moveable tops, so as to get the lime juice out with facility if it were frozen and perfectly hard, and also when it was liquid. At some periods of the northern journeys it would have become liquid, and they might have used it, as I stated yesterday, either in the rum or in the tea, or, what I still think would be a much better plan of using it, in the pemmican, either in a frozen or a liquid state. I think that they would have found it, as I said then, a very agreeable addition to their food, and it would have made it more palatable, the men would have taken it more readily, and it would have had a very beneficial effect, in my opinion, upon the assimilation of the food; and hence, taking their food regularly, and in the quantity prescribed, it would have prevented that debility which appears to have ensued at such a very early period, and that waste of tissue which arose from the men not having been able to consume their food, owing to their physical powers having been overtaxed; and from the exhaustion produced thereby they were consequently unable to repair the waste of body entailed by each day's excessive travelling.

9094. (*The Chairman.*) On this occasion the rum was not carried in breakers, but the party were supplied with cans, which was a better arrangement, probably?—I should have no objection whatever to its being supplied in tins, provided it afforded equal facilities for getting at the frozen lime juice, but of course it would require an opening of considerable extent, probably, to dig it out. I mention that, inasmuch as the lime juice would be more likely to keep liquid for a longer time in wood than in tin.

9095. (*Dr. Fraser.*) Do you think that it would have been impossible for the men to have consumed the ration of lime juice in a frozen state?—I think that it would have been very undesirable to have done so, owing to the excoriation that it would have frequently produced in the mouth, and it could not have been continued to be taken in that state.

9096. You think that the best method probably would have been to mix it with the pemmican?—I think so; or with the rum or the tea.

9097. I think you told us yesterday that, so far as any data exist, citric acid appears to be the only constituent of lime juice which possesses any of the prophylactic or curative power?—Yes, and in a very feeble degree, I think.

9098. Do you think that if a large proportion of the quantity of water were extracted from the lime juice, and an extract obtained similar to many extracts, that extract would probably be efficient, so far as you can judge in the absence of any actual experiments?—I should be very sorry indeed to tamper with lime juice in any form, and I could recommend nothing as a substitute for lime juice until its efficacy was as firmly established as that of lime juice is in the prevention and treatment of scurvy.

9099. You, of course, are very familiar with the taste of lime juice?—I am.

9100. Should you have any objection to taste a small portion of these lozenges (*handing some lozenges to the witness*), prepared by John Bell & Co., Oxford Street?—None whatever, but I have already tasted them. I have had them before me.

9101. Does the taste resemble that of lime juice?—The taste resembles that of lime juice; the lozenges prepared with sugar, I think, are very pleasant, so far as I can judge.

9102. (*Admiral Inglefield.*) But could you not test them chemically, so that you could be sure that all the ingredients existed in them the same as in lime juice?—They have been tested chemically and satisfactorily at Netley.

9103. Would not that satisfy you, then?—No; no

substitute will satisfy me as equal to lime juice, unless you use it and prove from extended experience in the same way that it is as efficacious as lime juice.

9104. Would you fairly call it a substitute, if it was merely deprived of all its watery particles, and it retained all the other chemical properties?—No, I would not be satisfied with it. I would admit of nothing in lieu of pure lime juice, certainly not on such a service where the lives of men are jeopardised.

9105. (*Dr. Fraser.*) Although you would not feel inclined to recommend it, yet still, if it were advisable to have a concentrated form of lime juice, do not you think that the probabilities are that it would be worth a trial?—This might appear to be a very desirable mode of carrying lime juice, as I say, when you can prove the fact that it is equal in efficacy to the pure lime juice itself, but not otherwise; no man would be justified in recommending an untried remedy, however efficacious it might ultimately prove upon experiment and observation, as a substitute for that in which we have unlimited confidence supported by a very large experience in all parts of the world.

9106. I think there would be no desire to adopt such a substitute until such experiments as you refer to have been made?—I should hope not, for the sake of those upon whom it was to be tried.

9107. Have you had occasion to observe the effects of a low and a high temperature upon lime juice?—Yes.

9108. And with what result?—No change.

9109. Are you aware that your observation coincides with that of Dr. Coppinger and others connected with the recent expedition, in the case of the lime juice found at Polaris Bay?—Yes; perhaps the Committee would allow me to put in a letter, which I received this morning, from the Professor of Naval Hygiene at Netley, where I desired some experiments to be made with lime juice; it is very brief and very satisfactory, and it bears directly upon the question which has been put to me, it is addressed to me and is as follows:—

"Lemon Juice from H.M.S.S. 'Alert' and 'Discovery,'

"Army Medical School, Netley,

"Sir, "February 20, 1877.

"Having, in compliance with your letter of the 20th ultimo, made a careful analysis of samples of lime juice from the arctic ships 'Alert' and 'Discovery,' I beg to submit to you the following results:—

"The specific gravity, taken at a temperature of 60° Fahrenheit, was found to be 1023, and after the alcohol was driven off, 1035·7. Proof spirit, 17·07 = 9·7 per vol., or 7·75 per weight.

CHEMICAL COMPOSITION.

Sample from H.M.S. 'Alert.'

	per cent.	grs. per oz.
Citric Acid	8·9900 ..	39·2
Extract	8·4965 ..	37·17
Ash: Total	0·36975 ..	1·62
" Insoluble	0·2901 ..	1·27
" Soluble	0·07975 ..	0·35
Chlorine	0·00550 ..	0·024
Phosphoric Acid	0·01875 ..	0·037
Potash	0·02464 ..	0·105

Sample from H.M.S. 'Discovery.'

	per cent.	grs. per oz.
Citric Acid	8·99 ..	39·20
Extract	8·661 ..	37·90
Ash: Total	0·337 ..	1·48
" Insoluble	0·231 ..	1·08
" Soluble	0·106 ..	0·462
Chlorine	0·00760 ..	0·033
Phosphoric Acid	0·013125 ..	0·057
Potash	0·02784 ..	0·122

"Remarks.—Both specimens of lime juice, in all their sensible characters, appeared to be quite sound;

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and, judging from the foregoing analysis, might be affirmed to have suffered no deterioration, either in composition or properties, by their exposure to very low temperatures.

"I have the honour to be, Sir,

"Your most obedient servant,

"JOHN DENIS MACDONALD M.D.,

"Deputy Inspector-General, &c."

9110. When lime juice is used as a prophylactic, is its action, in your opinion, more that of a food, or a food substitute, than that of a medicine?—More as a food substitute, I should say.

9111. And for what class of food is it a substitute?—For vegetable food.

9112. If, therefore, it be in a measure a food, there does not appear, does there, to be any good reason why the dose should be increased in direct ratio with the prolongation of its administration, if the general hygienic conditions are maintained in a good state?—No; I think that the quantity of lime juice ordered to be taken daily is ample to maintain a man in a fair state of health when no scurvy is present.

9113. Lime juice represents the vegetable element of food, I think you have told us. What were the food elements of the same class represented in the sledge party dietary in the recent expedition?—The only thing I can discover in the sledge dietary would be two ounces of potato and a very small quantity of onion powder, I should say an almost infinitesimal quantity of onion powder.

9114. Do you think that that was a sufficient quantity of the represented vegetable element?—No.

9115. It is, of course, a fact that, under this dietary, scurvy broke out; have you examined the medical reports with reference to that outbreak?—I have, so far as I have been able to do so.

9116. Are you able to tell us how many cases of scurvy occurred?—The documents are all before the Committee as to the number of cases of scurvy that occurred in each ship; but, speaking from memory, I think there were about 39 on board the "Alert" and 16 on board the "Discovery."

9117. You mean in connection with the crews of those ships, not on board ship?—Among the crews.

9118. Are you able further to tell us how many of these cases occurred on board ship, and how many while this sledge dietary was being consumed?—I am not able to answer that question directly. All those facts are before the Committee. I have read them, and I believe they are already in evidence. I am not aware at this moment.

9119. I think you prepared a report on the occurrence of scurvy in the recent expedition, which is dated the 13th of November, 1876?—Yes, in compliance with the directions of the Admiralty.

9120. In that report you express a general concurrence with the views of Fleet-Surgeon Colan as to the causes of the production of scurvy?—Yes.

9121. Can you tell us what Fleet-Surgeon Colan's views are?—They are recorded in his nosological return, and generally attribute the outbreak to the nature of the service, detailing the various causes, the great exertion which the men had to undergo in the absence of prophylactics, as well as I remember.

9122. In paragraphs 2 and 3 of this report you refer to the means which were adopted to maintain the health of the men previously to the starting of the sledge crews, and to the generally satisfactory result of those means, do you not?—Yes; but I find that this report was written with special reference to paragraph 2, when I was not in possession of so much information with regard to the dietary as I am at present.

9123. Does that further information lead you to modify any expression contained in that paragraph?—It proves to me that the instructions with regard to the diet were not carried out in the manner I expected.

9124. Does it lead you at all to modify the expression contained towards the end of paragraph 2, that nothing could well be more satisfactory than the

health enjoyed by the respective ships' crews during the winter up to the period of the dispatch of the sledge parties from the ships?—No, inasmuch as those men were all examined in accordance with paragraph 3, and reported to be in good health; but I think, had the diet list which I recommended been carried out, the men might, in all probability, have been in a higher state of vigour, and possessed a greater physical power, although to all appearance and on examination they appeared to be in excellent health.

9125. I gather, therefore, that you do not think that the absence of light, and the cold and damp, and, probably bad air, had produced scurvy, or incipient scurvy, at this time?—No, they had not produced it.

9126. Should you expect that they would do so?—No; they would deteriorate health, but not produce scurvy.

9127. Is it contrary to experience to expect that they themselves would produce scurvy?—So far as I know, it is.

9128. Is it contrary to your own experience?—It is; otherwise the "Investigator's" crew would have had scurvy long before the period at which they had it, they having been placed in much more unfavourable circumstances with regard to the daily diet.

9129. Are you aware that the absence of light was greater in the "Alert" than in the "Discovery," but that the difference was only for a few days?—Yes, I am aware of that.

9130. Whereas the number of cases occurring in connection with the men wintering in the "Alert" was very much greater than the number wintering in the "Discovery"?—Yes.

9131. You do not think, do you, that the difference of a very few days in the period of darkness would account for that great difference in the number of cases?—No.

9132. Have we any definite knowledge with regard to the effects of the absence of light on health; or what is your opinion as to the effect of the absence of light upon health?—I think it will tend to the deterioration of health, but it will not produce that specific disease called scurvy.

9133. Do you know of any data in existence for supporting that notion?—I am not aware of any.

9134. The absence of light will undoubtedly cause blanching, but I apprehend that that blanching is a different thing from the change of complexion observed in the early stage of scurvy?—Totally different.

9135. In the book which I have referred to, where you treat of the subjects of naval hygiene and scurvy, I think you divide that disease into three varieties, do you not?—Yes.

9136. The first of those varieties being incipient scurvy?—Yes.

9137. I think in this work you also state that among the most early symptoms of incipient scurvy, which itself is the earliest form of scurvy, there is loss of weight?—Apparently so; in fact there is, so far as my experience goes, a loss of weight.

9138. Then, I apprehend, that if you were told that at the end of the winter in the arctic regions the average weight of the two crews was increased, that would be corroborative of your opinion that there was no incipient scurvy at that time?—Certainly.

9139. We have had, in fact, a statement given to us of the weights of the men connected with both ships, on joining the ships and before the spring sledging. From that statement of weights, I find that, in connection with the "Alert," the gain per man in the spring among the officers averaged 5 lbs. 6 oz., and the gain per man among the crew averaged 3 lbs. 4 oz.; and in the case of the "Discovery," I find that the gain per man among the officers averaged 8 lbs. 13 oz., and the gain per man among the men of that ship averaged 7 lbs. 9 oz. That is a very considerable gain, is it not, for the period of time?—Yes, very considerable.

9140. Does that suggest that the nourishment and the general health of the men must have been good

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in the absence of any direct information to the contrary?—I think it suggests the idea that the officers and men in the "Discovery" may probably have had a larger amount of more nutritious food than they had in the "Alert," that is, contrasting the two ships.

9141. In paragraphs 4 and 5 you refer, do you not, to the overtaking of the physical powers of the men as an essential element in the production of scurvy?—Yes, in the absence of lime juice.

9142. That overtaking in the presence of lime juice, in your opinion, not being possibly an essential cause of scurvy?—It would be of debility, but not necessarily of scurvy. If the men had the advantage of lime juice, it would have produced debility, but not scurvy.

9143. Why do you think that the men were over-taxed?—I could only account for the sudden outbreak of scurvy by the existence of two causes, which were the over-taxing of the physical powers of the men from some cause or other whereby exhaustion was produced, that exhaustion preventing the men, as one of its effects, from taking the allowance of food in their daily diet, and hence they were unable to repair the waste of the body entailed by this undue exertion; so that, in my opinion, the men never recovered after the first day's march; and it was also due to the absence of lime juice at the same time. This opinion, the Committee will observe, was formed before I was in possession of the actual weights carried by the men, and I have made a statement to that effect in my report to the Admiralty in a postscript which was entirely confirmatory of the view which I entertained before I was in actual possession of all the facts, knowing that the suddenness of this outbreak could only occur from these two causes.

9144. What facts in the papers which you subsequently saw confirmed your opinion?—The weights dragged by the men, and the history of the expedition, as furnished in the sledge journals of the officers.

9145. Do you think that in all cases those weights were excessive?—I do.

9146. Have you any doubt that the weights were excessive, for instance, in the northern sledging party?—I have no doubt of it.

9147. From your perusal of the sledging journal of that party, can you tell the Committee what you estimate to have been the weight dragged per man?—I do not think any man should be set to work to drag, with an ordinary sledge equipment, in the present day, anything exceeding from 40 to 45 days; anything beyond that, I consider, will very seriously imperil any expedition, whereas these sledges were, I believe, equipped for 70 days. The task set to these men in this northern party was one of simple impossibility. I believe that had the ice from the "Alert" to the Pole been as smooth as a bowling-green, they never could have reached it under this equipment; and I think that the painful records of the journey will corroborate that view, inasmuch as those men's progress averaged, I fancy, little more than a mile a day, when at the same time they were travelling ten, and during that time making the most herculean efforts and struggling like heroes, as they were, in the attempted performance of an impossible duty. I should further say that in the "Investigator" I find in the spring sledge travelling our crew were only weighted 170 lbs. per man, which I think was wisely estimated to be as much as a man should be well set to do, with regard to the due preservation of health and efficiency. I think that men, under favourable circumstances of ice-travelling, might be weighted perhaps a little more; but on no account would I care to exceed 200 lbs. It is quite possible that somewhat heavier weight might be carried, but then it could only be done over very smooth ice where no impediments were met with, and where the sledge weights were daily decreasing. In my opinion, the Pole will never be reached unless food depôts be established at intervals on the route, excepting always the remote possibility of its accomplishment by a ship.

9148. Is it the case that in a cold climate, in order that the body may be properly nourished, a larger supply of food is required than in a warmer climate?—Certainly.

9149. And is a considerable portion of that increase in the direction of carbonaceous or fatty material?—Yes.

9150. Is it also the case, so far as your experience can lead you to offer an opinion, that when men are employed in sledging, and especially in sledging that requires very considerable physical exertion, they do not, as a rule, at first consume their full rations?—I have always found the men able to consume their full ration of food, but that, if over fatigued or exhausted, there was the same desire to take less food, as is felt in the case of exhaustion in ordinary life, and under ordinary circumstances.

9151. Then if it were the case that the men did not consume their full ration at first would you infer from that that they were over exhausted?—I certainly should.

9152. And you would, also, I have no doubt, infer that the nourishment of the body could not have been properly effected?—Yes; there must necessarily have been a waste of tissue and tendon caused by the great exertion which was not repaired.

9153. In the presence of that imperfect nourishment, of the heroic physical exertion, and of the absence of the vegetable element in the food, do you think it very extraordinary in the first place, that scurvy occurred?—I should have been very much surprised if scurvy had not occurred.

9154. Do you think it very extraordinary in the next place that scurvy should have occurred very quickly after those conditions existed?—Not at all.

9155. It did as a fact, I think, occur more rapidly, did it not, than previous experience would have warranted us to anticipate?—More rapidly than anything that my experience has made me acquainted with; but, under such causation, its early appearance may be readily accounted for.

9156. You do not think it at all necessary to include in the causation, in order to account for this exceptional rapidity, any deterioration of health during the winter, do you?—Not at all. All the knowledge before me leads quite to the contrary result. The men increased in weight, and were pronounced in good health on leaving the ship in the spring.

9157. You are aware, are you not, that a few cases occurred amongst the men who did not sledge, and were not exposed to those conditions?—Yes.

9158. Can you in any way account for the occurrence of those cases?—So far as I can form an opinion with regard to the occurrence of those cases, it appears to me that they were men with very much impaired constitutions; that they were men prone to intemperate habits, and they may, probably from some cause or other, have indulged in them surreptitiously on board ship. I think also that there was a disinclination on the part of one of them to take his lime juice, and I am not sure it was not so with both. I looked at it with special reference to the case in the "Discovery." The case, as well as I recollect, which occurred on board the "Alert," was that of the ship's steward, and I think it extremely probable from the nature of his duties that that man did not follow out the fair ship's routine, and he also was a man whose habits were prone to dissipation; these things, in my opinion, fully account for those isolated cases occurring, in addition to which there may have been constitutional peculiarities which would render those men more susceptible, from their being broken down men and men previously given to habits of dissipation.

9159. You are not of opinion, and do not at all suggest, that the general health of the crew was deteriorated?—By no means.

9160. Or that any scorbutic taint existed generally amongst the crew?—By no means.

9161. (*Admiral Inglefield.*) Can you give the Committee any information as to whether uncooked potatoes are a better antiscorbutic than when they

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are preserved in the manner in which they are generally issued?—I believe the uncooked potatoes possess higher antiscorbutic qualities than the cooked potatoes.

9162. You are aware of the extraordinary drift of a party of nineteen individuals from Polaris Bay, or rather from the neighbourhood of Lyttelton Island, down to latitude 58°, and that that party of people had no other provisions but pemmican and biscuit, besides the raw meat which they devoured from the flesh of seals and walrus?—Yes.

9163. And yet no symptoms of scurvy broke out in that party, although they were upwards of six months on the floe?—No.

9164. To what do you attribute this extraordinary immunity from all scorbutic symptoms?—I consider that it is owing to the fact that they got the meat in a raw state, in which no doubt it possesses, from the cause I stated yesterday, certain antiscorbutic properties; and I think it has been very well described in evidence which has been given to this Committee by Mr. Busk, who attributes this agency, that he can hardly trace to anything, particularly to what he calls living juices of uncooked meat, and that appears to me to have been the principal cause, in addition to which I have also learned, since this Committee has been sitting, that they had American pemmican which was mixed with currants and raisins; that may also have exercised a certain amount of antiscorbutic effect combined with the other, and I believe that there was no great deterioration of physical power, and no exertion. Those would appear to me to be the causes that warded off the scurvy amongst the "Polaris" men.

9165. We have had it in evidence from a man who was an ice master in the late expedition and had seen scurvy occur on board whaling ships, that the men who were invariably the soonest attacked with scurvy were those who were indolent lazy fellows, and who took no exercise at all; is that your view?—I am disposed to agree with him.

9166. Then the indolence of those men, of whom I was just speaking, on this floe, would hardly have been one of the causes of their not getting scurvy?—But I assume that in all probability those men on board the whale ships were those who kept below in a vitiated atmosphere, whereas the others were always in a very pure one.

9167. Then from what you say, and from the actual facts recorded of those nineteen men, the Committee may gather that your opinion is that raw meat, if used by men upon arctic sledging, would be more likely to keep off scurvy than pemmican or preserved meats?—Provided they could take it in sufficient quantity.

9168. You mean, provided that they could swallow such large rations as have been stated before us?—Yes; and that you could get Englishmen to eat it in an uncooked state.

9169. Then also, I may gather from what you have stated, that you consider the admixture of raisins and currants with pemmican advantageous?—It may have been so in this case, but my experience is rather against making pemmican in that way. I think the plain pemmican is that which the men would continue to consume longest; and there would be no necessity for any admixture with fruits, provided they had a due supply of antiscorbutics of another kind.

9170. Do you remember which expedition was supplied with pemmican which had raisins and currants mixed with it. I remember we had it in one of the expeditions, 1852, 1853, or 1854?—I remember that in a journey from the "Intrepid" to the "North Star," during our last winter quarters, we had a little sweet pemmican with the sledging party that I was connected with; but whether it had raisins or currants or not I cannot say; I rather think it was sweetened with sugar; but we never took it with so much avidity as we did the plain pemmican.

9171. I gather, from what you have said, that the

concentrated lozenges you would not be disposed to adopt until they had been fairly tried on an arctic expedition?—Certainly not, and their efficacy as fully established as that of lime juice is in the present day.

9172. Milk has been mentioned as an antiscorbutic; what do you think of it?—I have no doubt it is an antiscorbutic, but in the "Investigator" we were not supplied with any milk for general use.

9173. In your evidence yesterday, you said that you considered that the probable properties of raw meat, as an antiscorbutic, were the lactic acids which it contained?—Yes.

9174. Does not this seem to agree with what has been said before with reference to milk being a good antiscorbutic?—It would; lactic acid in combination with probably other elements of the vegetable acids.

9175. Are you aware that lime juice was not carried by McClintock, and others, on long sledge journeys?—Yes.

9176. Then to what do you attribute their immunity from scurvy during their very extended journeys?—I have already expressed my opinion to the Committee on that question, but I may again repeat it, by saying that I always considered those sledge parties to have been uncommonly well managed; great care taken of the men, not to produce any over fatigue or undue exhaustion; in fact, not to over-tax their physical powers, at the same time that they were very abundantly supplied with fresh meat, the produce of the guns, which had a very good effect in preventing the occurrence of any debility, and rather maintaining the men in a state of good physical power.

9177. Reverting once more to your very practical suggestion of mixing the lime juice with pemmican, do you think that the pemmican could be procured in the Victualling Yard with lime juice, as it is hermetically sealed afterwards in tin cases?—No, I should trust to nothing but having the evidence of the pure lime juice put into the pemmican at the time of using.

9178. Then the difficulty of carriage would not be met as regards the quantity of lime juice?—I never considered the difficulty of carriage any obstacle to taking lime juice in sledge parties.

9179. Would you object to its being concentrated, not in the form of lozenges, but into such a form as is shown there (*handing a specimen to the witness*), which represents ten ounces of lime juice minus the water?—I would, for the same reason that I have objected to the lozenges, that nothing should ever be considered a substitute for lime juice until its efficacy has been proved.

9180. But are you aware of the process by which lime juice is prepared in Sicily, from whence, I believe, the Government derive their supplies?—I have heard of it.

9181. And in that process a certain amount of the juices lose their watery particles by evaporation. Why may not that be carried to a greater extent, because the lime juice is an article of commerce; and is there any standard according to which it shall contain so many particles of water as a constituent part?—I think that a certain amount of water with the lime juice, as at present, is necessary to its efficacy.

9182. Is it in the administration, or in the carriage of it, that you mean it is necessary?—In both.

9183. Then you think that lime juice to be useful must only be carried in the condition in which it is an article of commerce?—Certainly, so far as our present experience goes; and it would be most unsafe and, I consider, unwise to carry it in any other way until we have the fullest evidence of the efficacy of the substitute.

9184. Might not the efficacy of this concentrated lime juice be tried on board the "Dreadnought," or other ships where scurvy is constantly exhibited?—I think it might.

9185. Then it is quite within the power of medical practitioners to ascertain the fact of the propriety of concentrating lime juice, without sending it on an arctic expedition?—I think it would be very desirable to do

so before it was used on an arctic expedition, or for service in the navy or merchant service of the country.

9186. (*Admiral Sir R. Collinson.*) In the passage from England to the Sandwich Islands, I think you were at sea nearly five months altogether?—We were at sea from the 20th of January to the 4th of July.

9187. And during that period you got about three days' fresh meat, and no vegetable food whatever?—Nothing whatever, except the beef which Captain Collinson, who commanded the expedition, had provided for us on our arrival at Magellan's Straits.

9188. Then this voyage, I take it, is an almost unprecedented period in the navy for ships to be at sea without fresh provisions?—It is, at the present day.

9189. And what was the state of the health of your men when you arrived at the Sandwich Islands?—The state of the health of the men was good.

9190. Were there any scorbutic symptoms?—None whatever.

9191. Passing from the Sandwich Islands, where I think you received a great amount of vegetables and fresh food, we come now to your next supply from the Esquimaux, and from birds which you shot along the coast of America; was that supply in any great quantity?—I should remark, in the first place, that we got one bullock and twelve sheep from the Sandwich Islands only. The supply of vegetables that we received at the Sandwich Islands was of a very limited character, inasmuch as the markets had been almost denuded of vegetable food by the whalers coming in from Behring's Straits, and I may also add by the "Enterprise," which had preceded us a few days before, and hence the scarcity of the supplies was a matter of great regret to us.

9192. And along the coast of America, did you get much fresh food?—Very little indeed; a few fish, and occasionally a few birds, but very little.

9193. And throughout the whole of the voyage, from entering the ice to the time of your being shut up in winter quarters, the ship's company were exposed to a great amount of fatigue?—Very great indeed.

9194. And a great deal of wet?—A great deal of wet, and working the ship through the ice throughout the whole of the twenty-four hours sometimes.

9195. On your being caught in the ice off the Princess Royal Island, the ship continued to move for a considerable period before she was firmly fixed for the winter?—Yes, and at times helplessly drifting in the pack.

9196. Could you say about what periods the labour of the ship's company ceased in having to expose themselves in looking after the ship?—We drifted, in fact, until the beginning of October, when we may be said to have got into our winter quarters. The ship's company were a good deal employed in housing, in making roads through the ice occasionally, and in various other duties.

9197. Had you any sledge journey that autumn?—Yes; we had a few minor sledge journeys, but one in particular; also in October, when Captain McClure proceeded with a party to the entrance of the straits, with a view of establishing the existence of a north-west passage, which we had previously confirmed on a short expedition to the neighbouring land, when we saw the entrance from the strait we were then in, into the Strait of Barrow, thus establishing the existence of the north-west passage, which Captain McClure in his subsequent journey was anxious to confirm by actual observation.

9198. Then, from January to October you consider the ship's company underwent a great amount of labour with scarcely any vegetables except what was received at the Sandwich Islands, and their health at the close of the autumn navigation was good?—Wonderfully good.

9199. To what do you attribute that?—I attribute it to the extreme regularity with which lime juice was given to the officers and men, without one day's intermission.

9200. Was that amount an ounce per man?—One ounce per man.

9201. In the ensuing spring, I believe, three lengthened sledge expeditions were despatched from the ship?—Three expeditions were despatched from the ship, each provisioned for forty days. One party remained out forty days; the second party returned after an interval of eighteen days, but was despatched again the following day, and was absent twenty days longer; the third party returned after thirty days with two men on the sledge crippled by frost bites.

9202. I believe you have stated already that these sledges carried no lime juice?—They carried citric acid.

9203. In lozenges?—In its crystallized form; Captain McClure declining to accede to the recommendation which I made that lime juice should be sent.

9204. What was the condition of the men on their return from these expeditions?—The party that was absent longest, and had the opportunity of getting fresh meat in the southern journey, were very well, and, I think, as well as my recollection serves me, stouter than when they left us. The other parties were in good health.

9205. Have you any recollection as to the weight carried on the sledges on that occasion?—170 lbs. per man. The average weight of our sledges, I should remark, was 1,028 lbs. to six men; the officers did not count.

9206. Then when the ice enabled you to move, you proceeded up to the head of the Prince of Wales's Strait, and then round on the west side of Behring's Land?—Yes, we made an attempt to get into the Strait of Barrow, and, failing that, we then went round on the land.

9207. Was your ship's company exposed to great labour and hardship during the course of that summer's voyage?—They were; the ship was so often placed in the most critical and dangerous position.

9208. On arrival in Mercy Bay, I take it for granted that your labours comparatively ceased?—No; I cannot admit that. The labours of the crew in endeavouring to procure fresh meat, reindeer, in hunting were very considerable indeed, inasmuch as they had to travel over the land in deep snow, long distances, in search of the deer, and they frequently came on board after a day's hunting in a very exhausted state.

9209. And the supply obtained was considerable?—The supply obtained was considerable. I think, during our sojourn in Mercy Bay, we got about 112 reindeer with some ptarmigan and hares. I could furnish the Committee with the game list, if they thought it desirable for me to do so, but the aggregate weight of meat that we got throughout the whole of that period of two years might have amounted, probably (speaking from memory, at this moment), to 11,000 lbs.

9210. That would be about twenty days' rations?—Probably it might be. I could furnish the Committee with the amounts, if they desire it. My narrative, which is on the table, I believe, gives a list of the game shot.

9211. Now, in the commencement of your second winter, I believe your provisions were reduced?—Our provisions were reduced.

9212. To the extent of a quarter of a pound of meat?—Our provisions were reduced from three-quarters to half a pound of meat per day. The vegetables were not reduced, but we lost cranberries, and some other changes were made, which are fully stated in the diet list which I placed before the Committee yesterday.

9213. (*Dr. Fraser.*) May I ask if the game is put in this diet list which you refer to?—No.

9214. Would it not be the most convenient way to add a note stating that fact about the game?—But the game did not supplement the diet, it was a substitute for the diet. The day that we got a pound of fresh meat, or a pound of birds, we did not get the ship's provisions; it was not an extra at all.

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9215. (*Admiral Sir R. Collinson.*) At the commencement of the following spring what was the condition of your people?—You mean the spring of 1852? There was evidence of loss of flesh and a growing debility which culminated in scurvy, and I consider that that debility which manifested itself about February or March was a premonitory sign of scurvy.

9216. Then the men at this period, when these scorbutic symptoms appeared, were taking their full allowance of lime juice?—No; the lime juice in the previous autumn, in October, had also been reduced to two-thirds of an ounce, with the reduction in the food, a matter which was to me a subject of the deepest regret, looking to the effect which I feared would ensue, and which did ultimately ensue.

9217. In the spring of 1852, but one sledge journey of any length was made, I believe?—Only one.

9218. And that for not a lengthened period?—Captain M'Clure went from the "Investigator" to Melville Island; to the best of my recollection, I think he was absent twenty-eight days.

9219. Then are the Committee to understand that the ship's company of the "Investigator" were not exposed to great labour during that summer?—They were incapable of undertaking great labour; there was a great reduction in their strength; there was a growing tendency to scurvy, many cases having occurred, and from the paucity of food on which they existed, there was a great disinclination on the part of the men to exertion. We had not food, either animal or vegetable, sufficient to maintain us in health and vigour.

9220. Do you consider that the paucity of food had a tendency to produce the scorbutic symptoms?—The paucity of food tended to diminish our physical power and to reduce our flesh, and in that way of course acted as a predisposing cause, together with the diminution in the quantity of antiscorbutic food, vegetables and lime juice, both of which were diminished in quantity.

9221. Then for the third winter your people were in a more exhausted state?—In a more exhausted state.

9222. Until at last, I think you said in your evidence, that there was scarcely a person on board the ship who was not tainted with the disease?—I believe that we were all more or less affected in various degrees, but not sufficiently so to render some of us incapable of making still greater exertions in the chase with a view of obtaining supplies. I refer particularly to officers; the men did not make the same exertions at this time, but the officers considered it a point of stern duty that one or two from the mess should go out daily, however low the temperature, when we could possibly face it.

9223. When the communication was opened with the "Resolute," were the ship's company at once placed on full allowance?—No; we were placed in communication with the "Resolute" by the arrival of Lieutenant Pim, five dogs and two men, who performed in a most heroic manner a very trying journey at the earliest period of the year on record, and travelling at, I believe, as I have already stated, the lowest temperature recorded. On his arrival, and after one day's rest, Captain M'Clure returned with him to the "Resolute" to consult the senior officer. In due course he returned with the orders of his senior officer as to our future proceedings; but no change was made in our dietary until it had been finally resolved on that the ship should be abandoned after the return of Captain M'Clure.

9224. How long was it before you abandoned the "Investigator" after the return of Captain M'Clure?—Captain M'Clure returned on the 19th of May, and we abandoned the ship on the 3rd of June; it was about a fortnight, therefore.

9225. Did the men's health improve at once?—I think the ship's company were allowed food and provisions to the fullest extent, everything that could be desired, after the decision was taken of abandon-

ing the ship, and no doubt their health and vigour became sensibly improved.

9226. And had you much difficulty in getting to the "Resolute"?—We had as much difficulty as might have been expected under the circumstances; but we adopted the wise mode of travelling, for debilitated men, of sleeping and travelling every six alternate hours, which husbanded our strength greatly, although at the end of the journey we were very much broken, and all more or less ill.

9227. Were you obliged to carry any of the men on the sledges?—Occasionally we had to carry a man for a short time.

9228. And were the weights heavy?—The weights were under 200 lbs. a man, carrying our provisions and all the personal effects we could.

9229. On your arrival on board the "Resolute" you were placed upon a full allowance?—A very liberal allowance of food.

9230. And the men at once began to recover?—At once; the change observable in the men who had preceded us by about a month, on our arrival at the "Resolute" was such as could hardly be credited.

9231. You were the last party that left the ship?—We were the last party that left the ship.

9232. In the ensuing spring you had an opportunity of seeing the sledges depart from the "Resolute" under Captain M'Clintock?—No; those journeys had taken place before we arrived at the "Resolute." I saw Captain M'Clintock return, I was there when he returned.

9233. You witnessed the return of the sledge crews after their long absence?—I saw many of them; I saw Captain M'Clintock's.

9234. What was the condition of his men?—I thought they were all very much broken, but in apparent health.

9235. Then Lieutenant Mecham's party, did you see their return?—I did not see the return of that party.

9236. As to the accommodation on board the "Investigator" and the "Resolute," although you lived on board the "Intrepid," you possibly would be able to tell the Committee whether there was much difference in the accommodation between the two vessels?—I think the accommodation on board the "Resolute" was superior to the "Investigator's."

9237. In what way?—I rather think she was a larger ship to begin with, and it appeared to me that there there was more space between decks.

9238. At the commencement of the last year, what was the comparative condition of the crews of the "Investigator" and the "Resolute," was there much difference between them?—No, I think the "Investigator's" crew had recovered so rapidly, that I should almost consider them in as good condition as the "Resolute's," except in a few cases.

9239. There were some serious cases?—Yes.

9240. And I believe that during the period that you were on board the "Resolute" you got very little fresh food?—We got a great deal of fresh food, more fresh food than we ever got in the "Investigator."

9241. Musk oxen?—Reindeer chiefly, and musk oxen as well, the best dietary we ever knew in the Polar Sea, much better than anything we had ever been accustomed to in the "Investigator."

9242. In the case of the "Resolute," I believe the diet was very similar to that which was prescribed for the use of the recent arctic expedition by the Arctic Committee?—It is probable that it may have been; but I should say (this might be the proper time to mention it to the Committee) that I objected to the dietary as laid down by the Arctic Committee in a representation to the Board, on the ground that there was very little difference made, that the dietary was not so good as it would be in a ship on home service, with the exception of a few articles of antiscorbutics. I have got a copy here of my letter to the Board, if the Committee wish to possess it.

9243. (*The Chairman.*) Will you read it, and then put it in?—This is a copy of my remarks to their

Lordships on the scale of diet for the arctic expedition:—"26th January, 1875. With reference to the directions contained in their Lordships' letter of the 21st instant, I would observe that, as I am not yet aware of the medical comforts that have been selected for the arctic expedition from the list furnished by me, I am not yet in a position to draw up a scale. In regard to the daily diet list forwarded, I am unwilling to lose a moment without expressing my opinion to their Lordships of its inadequacy to maintain men in a state of health and vigour in the polar regions, and I would now beg strongly to urge on their Lordships' consideration the absolute necessity which I believe exists of increasing the amount of animal food in a very considerable degree; and as far as possible in accordance with the opinion expressed in my submission of the 12th ultimo; their Lordships will perceive that the quantity of meat is the same, and that of bread and biscuit actually less than what is given to men in tropical or temperate climates; and it will be obvious how much this proposed scale will fall far short of nature's requirements in the arctic regions, notwithstanding that it is supplemented by a few antiscorbutic articles of food. That men can exist on it for a time I will not deny, but it will be at the expense of their health becoming more or less deteriorated, and such deterioration will increase until debility, of a scorbutic character, becomes established. It is as a preventive measure that I urge the necessity of a more liberal diet, based on an experience of a character painful to remember, and such as was entirely unknown to other polar expeditions. I do not think this diet scale should be framed on the chance of procuring game. It should, in my opinion, rest on a more solid basis, for if game can be procured in the abundance anticipated, it can either be substituted for the daily ration, or supplement it in lieu of a portion of provisions, and hence it is that I am anxious to urge on their Lordships a re-consideration of this question, and on which I would beg to submit, that the opinion of Captain Nares might be taken."

9244. (*Admiral Sir R. Collinson.*) In consequence of that representation, are you aware that the amount of meat was considerably increased?—I believe it was increased very considerably, and that the Admiralty sent the "Valorous" out with as large supplies as, I believe, the two ships could stow of fresh meat, to meet the views which I entertained.

9245. You have seen by the returns forwarded to you, that both in the "Alert" and in the "Discovery," as winter came on, the ration was increased?—But not to the extent that I recommended; in fact, the diet list varied so much that it would be difficult to say what was the diet.

9246. On the question of the arduous labour undergone by these people in dragging the heavy weights, have you taken into consideration the circumstance that, as the men had to double-man and walk back, they were really not so much exposed for a lengthened period to the drag-rope as Admiral Richards' or Admiral McClintock's sledge parties?—They were exposed sufficiently long to that severe labour to have produced exhaustion, which I consider was a great evil.

9247. Men had to walk back in order to bring up the second sledge, and consequently for a portion of the period they were walking, not dragging?—I think that the nature of the walking itself was fatiguing to them, considering the ground which they had to traverse and the depth of the snow, and rendered still more so of course from bringing up the sledges; and such an amount of fatigue and exhaustion was produced as, in all probability, was not encountered by any of the Southern parties for so long a period.

9248. Have you any opinion with respect to the greater amount of exhaustion caused by a standing pull, or leg dragging. I mean this, by a "standing pull" we hear that the men were occasionally obliged to face the sledge?—I think that is more exhausting than a fair continuous drag.

9249. The drag-rope would not bring such a continuous tension on the fibres of the body?—I think that the work you speak of is very exhausting.

9250. With respect to the return by Dr. Colan, I find in it that the first person affected with scurvy was attacked ten days after the sledges started; a man of the name of Berrie. He came back to the ship: his journey was what I may call an along-shore one; he was not out in the heavy pack that the others were, and yet he was laid up without, as it were, going through this tremendous exposure which the other men had?—I fancy he must have had an exposure and fatigue beyond his power, and that exhaustion ensued in the same way as it occurred to stronger men.

9251. He was sent back in consequence of showing debility?—Yes.

9252. Then the next one is a man of the name of Simmonds, who had been a dog-sledge journey to the "Discovery" and to Greenland, so that he was but a very short period absent, and in a dog-sledge he would not be exposed to the same hard labour as the others would?—I can only say that the labour of each man must have a relative tendency as to the powers of endurance whether one man might not endure more for a long time than another.

9253. Then we come to Vincent Dominique, who was ship's cook, and therefore was exposed to no labour at all; he was on a list with a frost-bite contracted in a sledge-journey in the autumn, he exhibited sponginess of the gums, but had not been exposed to the spring journeys?—I would infer from that, that in all probability he had been one of those men called idlers, and that he neither took the due quantity of exercise during the winter to keep him in health, nor was it imposed on him; and I have generally found that the men most prone to remain on board ship and take less exercise, were more deteriorated in health than the others.

9254. The next was the case of an ice quartermaster, who had been two sledge journeys, neither of which extended as far as Cape Joseph Henry?—It is an important thing, in mentioning those cases, to state age.

9255. This man's age was 30; his absence must have been very short from the ship, I do not suppose as much as six days at any time?—In a case of that kind I fancy the man may have been probably less vigorous in constitution than the others, and more easily affected by a less amount of labour.

9256. Now we come to the ship's steward, whose age was 31, and he had been on the sick list since the 8th of April, and had an injury to the lower part of his thigh caused by the pressure of a heavy cask of provisions; but this ship's steward would not have been exposed to any serious labour, would he?—I think that I answered about the case of the ship's steward in replying to a question put to me by Dr. Fraser. The ship's steward, I believe, was a man of intemperate habits, and he also was a man in all probability who did not take his regular amount of exercise.

9257. I now come to one of the ice quartermasters, who had also been two sledge journeys, which had been for a short period (his age is thirty-six), so that he would hardly have been exposed to the same labour as the others who went over the ice?—No; but he might have been subject to sufficient labour to produce the same effects; and the question of his age had also to be considered, as I generally find that the younger the men are, the greater is their power of resisting the effects of the scurvy.

9258. Then I have two more cases; Benjamin Wyatt, aged twenty-five, who had been across the straits to Polaris Bay and back to the ship; he could have only been absent a very short time?—How soon, might I ask, did the scurvy make its appearance?

9259. On May 20th?—How long after the journey?

9260. He left the ship on the 6th of April, and reached the "Alert" on the 15th, and then he leaves the "Alert" on the 21st of April, and gets back to the ship on the 1st of May, consequently he had six

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days on board the "Alert"?—I would attribute it in that case, certainly, to the same cause, and also to the deprivation of lime juice where men are exposed to exertion, and I assume that the exertion in all these cases was very great.

9261. Here is another short journey, James F. Cane; he had been on one sledge journey to near Cape Joseph Henry and back; he is aged 24, and he was the armourer, and he appears to have been attacked by scorbutic symptoms upon the same day as Wyatt; he does not appear to have been exposed to the same labour as the others?—I fancy that his case might be considered somewhat under the case of idlers; the armourer is a man who is a great deal on board the ship; and what I said regarding the cook is somewhat applicable to him.

9262. Would you not have been surprised if men in a similar condition on board the "Investigator," performing short journeys like these, had been attacked?—I would have been surprised, inasmuch as we never allowed anybody to evade the prescribed exercise on board the "Investigator," which I consider was most valuable to the men; but I cannot discover that the prescribed amount of exercise was carried out on board the "Alert."

9263. You have mentioned the lowness of the temperature on board the "Investigator"; were your thermometers ever tested?—Yes; and they were tested before we started.

9264. Did you test them with the freezing of mercury?—Yes.

9265. So that is a corrected test?—Yes.

9266. (*The Chairman.*) In reference to this letter of the 26th January, 1875, which you have produced, I find the following memorandum in the Minutes of the Arctic Committee: "Memorandum from the Medical Director-General of the 26th January, 1875, repeating his opinion that there should be a more liberal diet in regard especially to animal food and bread than has been proposed by the Committee, and calling attention regarding these points to the opinion expressed by him in his submission of the 12th December, 1874, and that no reliance should be placed on the chance of procuring game. The Committee reported that they did not intend the scale of provisions as used by them should be imposed on Captain Nares, but that they had adopted a scale in order to arrive at the quantities of provisions to be prepared"; by which I understand that Captain Nares was left at full liberty to use whatever diet he pleased?—I should assume so from that.

9267. At question 469, Captain Stephenson is asked this: "Still the danger did not then occur to you; one case did not suggest the danger"; and his answer is: "No. The Medical Director-General had told me before we left England that the chances were that scurvy would not break out the first winter; we might possibly have it the second winter, and would be almost sure to have it the third winter." You see no reason to alter your opinion upon that point, on the assumption that the suggestions contained in your memorandum had been duly complied with?—I would add, that this was in the course of conversation, but I never anticipated that, supplied as the ships were, and being the best equipped vessels that ever left England on similar service, if the suggestions and recommendations had been carried out, scurvy would have appeared the second winter even, and, perhaps, not the third.

9268. The concluding paragraph of these suggestions is to the following effect: "Looking to the fact that this expedition will be one purely of exploration and discovery, and, unlike former ones, will be emancipated from the more trying duties of search, and with a greatly improved dietary, and supplied with all modern improvements suitable to the service, I am of opinion that if the crews have been carefully selected, and the sanitary rules be strictly enforced, the ships' companies should enjoy an immunity from scurvy and a freedom from disease hitherto unknown in arctic expeditions." I gather from the tenor of your evidence

that you see no reason whatever to alter that opinion?—None whatever; and I may add that if I had to draw up the same recommendations again, as I did on this occasion, I could not alter or amend one line of them.

9269. I gather further from your evidence speaking briefly, that the points to which you have taken exception, are as follows: First, that the dietary during the winter was not duly attended to as you intended, in point of its being, to a certain extent, varied?—And in regard to quantity.

9270. Secondly, that you are not satisfied that the amount of exercise was sufficient?—There is nothing to show that it was the same as that which was recommended.

9271. We have it in evidence that the ships' companies could not eat what they were allowed: would you be disposed to consider that rather as a proof that the exercise was deficient?—It would certainly appear so, as my experience is entirely opposed to the idea that men could not consume, in the polar regions, and under the same regimen that existed on board the "Investigator," much more than the allowance of food with which they were supplied.

9272. And therefore that the circumstance which I have mentioned was one which should have drawn the attention of the officers to that very point of exercise?—I think so; in addition to which there is no proof that the diet was ever placed before the men. So far as I can gather from the evidence, it was left to the very loose and hear-say evidence of one or two or more petty officers; but there is no absolute fact in the evidence that I can discover showing that the men themselves were disinclined to take the food if it had been placed before them in the proper quantity at the proper meals. The custom in the "Investigator" always was, to form an opinion as to what was necessary to maintain the health of the men, between the captain and myself, and we imposed that; but we never sought the opinions of the men or petty officers as to whether the diet was sufficient, or insufficient.

9273. Adverting to the sledge dietary, I think you have stated that the only articles in it which can be viewed in the slightest degree as antiscorbutic, are the potato and the onion, and curry powder?—I fancy so.

9274. And they are rather mild antiscorbutics, I presume?—The quantity of each is so small that their effect as antiscorbutics must necessarily be extremely feeble.

9275. But even taking the preserved potato in any quantity, would you consider that to be strongly antiscorbutic?—I do not consider it strongly antiscorbutic; but that the potato, in quantity, does possess antiscorbutic properties, I think nobody can deny.

9276. But not at all to be compared with those of lime juice?—Not at all to be compared with them.

9277. Now in the event of a man being taken with scurvy on one of those sledge expeditions, I understand from evidence already given, that the only measures which could be adopted would be an increase of the potato, reduction of the spirits, rest, and, above all, as speedy a return to the ship for medical treatment as possible?—I consider that the manifestation of a case of scurvy on such service as that, deprived as they were of antiscorbutics, might be taken as evidence that other cases would also occur; and I consider that it would have been wise, after an interval probably of a day or two, that the sledges should return to the ship, rather than prosecute a journey which was likely still further to develop the disease.

9278. And therefore you consider it imperatively necessary that the officers detached on expeditions of that kind should be furnished with medical instructions which would enable them at once to detect the first symptoms of scurvy?—My book was furnished to the expedition with a view that all officers placed in similar circumstances should have an opportunity of reading it, and making themselves acquainted

with scurvy, which, up to very recently, I assumed they had done. I think, as I stated yesterday, that it would have been desirable that those officers might be able to recognize scurvy when it occurred, and if my work on the subject had been read, they necessarily would.

9279. My question rather points to this: viewing scurvy to be by far the most dangerous casualty to which these detached parties would be exposed, would it not, as a matter of common sense and prudence, have been desirable that, to meet this, the greatest danger of all, the officers should have been supplied with special instructions with regard to it?—I think it would have been desirable that they should have been made acquainted with the symptoms of scurvy, but also, as I stated yesterday, that they should have had instructions to return if it appeared.

9280. And further, that when these officers were detached on a service of this description, they should have received instructions from their commanding officer how to act when cases of scurvy occurred, thus relieving them from a very heavy responsibility?—They should; but as no provision was made for meeting cases of scurvy, it may hardly have been considered necessary by those responsible for it to send any instructions, inasmuch as they would have been unable to have met the disease when it did occur, in the absence of proper antiscorbutics.

9281. In regard to the difficulties that have been suggested as to the carriage of lime juice, it has been suggested that the lime juice should have been substituted for certain other articles in this sledge dietary; but would not the best mode of meeting the difficulty have been simply by reducing the number of days' provisions on the sledge, in proportion to the weight required of the lime juice?—I should be very slow to interfere much with the provisions. I think you might take an ounce from the pemmican and diminish the quantity of sugar, which would compensate for the extra weight of the lime juice. I think the reduction of an ounce of pemmican would be a matter of no great consequence, but one very immaterial.

9282. Commander Markham has furnished the Committee with a calculation that upon fifty days' provisions for a sledge, the number of days that would have been reduced, in order to enable them to carry the proper proportion of lime juice, would have been only three, thus reducing it to forty-seven days. Surely that would have been the most sensible way of dealing with the question?—No doubt. I think no sledge should be weighted beyond fifty days' travelling, rather under; from forty-two to forty-five days is the period I would recommend.

9283. I presume that the senior medical officers of each ship were selected for this especial service on account of their recognised professional ability and previous good service; that is correct?—Yes, quite correct.

9284. And, by the letter which I hold in my hand, of the 3rd of November, 1876, does it appear that their Lordships have been pleased to recognise that the services of these officers have been such as to meet their entire approval (reserving the question of scurvy) by promoting three of these officers, and by stating that the other would be favourably noted?—Yes.

9285. Referring again to your memorandum of suggestions and recommendations, in regard to which you stated that you considered that the mode in which it was forwarded to the commanding officers and medical officers of the two ships, virtually converted it into an order. I hold in my hand the covering letter with which it was forwarded to these officers, which I will read: "With reference to an application from Dr. Colan, forwarded by Captain Stephenson on the 11th March last, I am commanded by my Lords Commissioners of the Admiralty to transmit to you, for the information of Captain Nares, Captain Stephenson, and the medical officers of the 'Alert' and 'Discovery,' a copy of a memorandum, dated 30th

ultimo, from the Director-General of the Medical Department of H.M. Navy, containing recommendations and suggestions in regard to the preservation of health of the ships' companies during the forthcoming expedition to the polar regions." Now, in this letter, I find that the word "guidance" is omitted, which leads me to ask you whether (recognising fully that these suggestions were such as no officer would be entitled to disregard except under a very grave responsibility), looking to the terms of the covering letter, you would be disposed to alter your opinion as to the memorandum having been converted into an absolute order. In a covering letter of this description, "information and guidance" would have rendered it an order?—I am quite aware of the distinction drawn; but when the Admiralty again made special mention of those suggestions and recommendations made by me in their sailing orders to Captain Nares, I am under the impression, as I stated yesterday, that they fully intended that they should partake of the character of orders, forming, as they did, an integral part of the sailing orders to Captain Nares, and that they should have been acted upon as such.

9286. Will you point out to me the paragraph?—As this paper is headed "Sailing Orders" for H.M.S. "Alert," and is signed by a Secretary of the Admiralty, all that is contained in it must, I presume, bear the character of orders. The paragraph commences at page 4 (I assume it is an order), that "Timely endeavours should be made to secure anchorage suitable for winter quarters, and every precaution during that rigorous season, which your former experience, as well as that of other arctic voyagers, may suggest, is to be taken for the health and comfort of the officers and crew. Ample supplies have accordingly been furnished to the expedition, and you have been furnished with a memorandum from the Director-General of the Medical Department of the Navy on the subject." I necessarily assume that, coupled as they are in the same paragraph, the words "is to be taken" carry with them the same force of an order, as to the health and comfort of the officers and crew, as the words do in reference to anchoring the ship.

9287. Waiving the point whether these suggestions became absolutely an order, or whether they were merely suggestions which no officer could disregard without incurring a grave responsibility, I now refer you to Question 2053, which is put to Dr. Colan, the senior medical officer of the "Alert" to the following effect: "In these instructions" (that is the instructions to the sledge parties) "was provision made for scurvy? (A.) There was no mention of scurvy in them. (Q.) Could you give any reason for the omission of instructions upon this point? (A.) I followed out the instructions I had received, which were to give a small supply of such medical appliances and medicines as might be considered by the senior medical officer of the ship suitable for meeting slight ordinary casualties and illness, and to give clear and well-defined instructions for use. (Q.) In reference to an answer you gave Dr. Fraser with reference to the omission of lime juice in the sledge journeys, I would wish to ask you whether Sir George Nares, when saying that he could not give the lime juice, gave any reason for not doing so? (A.) He said to the effect that it could not be sent unless other things most essential to sledging were left out. I afterwards ascertained that its weight and that of the fuel required to melt it, were the reasons for its not being sent." Then, turning to Question 2130: "These instructions are called for, but I should like to know briefly, did they contain distinct instructions as to the symptoms of scurvy when first making its appearance, and how to treat them? (A.) No, there was no allusion to scurvy in them. (Q.) No allusion to scurvy in these instructions to the sledging parties? (A.) No. (Q.) Then what were the instructions that you gave? (A.) I gave instructions on all slight cases of diseases supposed to break out in arctic

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service. (Q.) But surely in reading the accounts of other voyages you must have had it in your mind that it was possible that symptoms of scurvy might develop themselves, even after one winter? (A.) I acted up to my instructions in issuing my instructions to the officers of the sledging parties. I gave them in writing directions which I inferred from my instructions. (Q.) These instructions were issued to you by the commander of the expedition, by Sir George Nares, were they? (A.) No, by the Medical Director-General. (Q.) Then in making use of those as your guide you considered that the supply should only be such as might be considered necessary for meeting ordinary slight casualties and illness? (A.) Yes; I will answer your question in this way. It was my study for a long time as to how I could carry out this recommendation, as I had no guide whatsoever in any book of arctic travel to direct me. I did get some hints from a manuscript kindly lent to me by Sir Leopold McClintock; and taking those as the basis, I made out a scale of surgical appliances and medicines for sledge travelling. I wrote clear and well-defined, though minute, instructions for the use of these appliances and medicines in the treatment of the slight ordinary casualties and illness that might take place. Those instructions I gave to the sledging officers to copy into their sledge journals, and I corrected their manuscript afterwards, and I taught the petty officers of sledges the use of certain medicines and appliances." Turning now to Question 2139: "Then, as a matter of fact, the instructions to the officers in command of the sledging parties contained no allusion to the possibility of scurvy breaking out, or the remedies to be adopted in such a case? (A.) I told Captain Markham that if scurvy did break out he had better give the men as much onion powder and potato as he could. (Q.) That was contained in a verbal communication? (A.) Verbal; and I also pointed out to him that when a man complained of internal pains and occasional spitting of blood he would be good for nothing, but to be taken great care of, and given as much food as possible, and that that man had probably scurvy." Then Dr. Ninnis, at Question 2721, is asked this: "Then the medical instructions which were issued to the commanders of the sledge parties had only for their object the possibility of casualties and ordinary maladies, such as constipation and diarrhoea? (A.) That is all. (Q.) Did you recommend that the sledging parties should take lime juice with them? (A.) I discussed the question with Captain Stephenson, but I did not urge it as a point of vital importance. (Q.) But with your present information, you would not hesitate now to press it as a necessity? (A.) I should not." Referring to these suggestions and recommendations of yours in the 11th Article, I find: "The use of lemon juice, when travelling, should be enforced in the same manner as already recommended for the men on board the ship." Now, the question that I desire to put to you, is this: "Was it not clearly the duty of the medical officers of the ships, having these instructions or suggestions from the head of their department in the service, the importance of which I have fully recognised; I say, was it not their imperative duty to urge upon the captains of the two ships, in the strongest possible way, the necessity of sending lime juice with these parties?—It is shown in evidence that Dr. Colan made the necessary representation, and it is acknowledged by Captain Nares that he did so. His duty appeared then, in his opinion, to have concluded; but I think it a most important point, with regard to the omission of lime juice, considering that a medical officer has really no power beyond that of recommendation, that the captain should have consulted the fleet surgeon fully as to the nature of the sledge travelling, instead of finally deciding on the matter, without previous consultation with the medical officers, and then it would have more clearly appeared that he had urged the necessity of lime juice; and he ought, in common consultation, to have seen what could have been omitted on the sledge, how the weights could

have been apportioned so as to enable them to take the lime juice; but the first step, I think, should have proceeded from the captain, in consulting with the fleet surgeon, as to the general physical character of the men and the weights to be taken on the sledges, and its bearing as a sanitary question.

9288. Fully admitting all that, and the disagreeable position in which an officer is placed, by finding himself in antagonism to his commanding officer; still, when the commanding officer had failed in his portion of the duty, surely that rendered it only more incumbent upon his subordinate, considering the vital importance of the question, that he should have remonstrated with his commanding officer as strongly as he could?—I consider that when a representation was made by the fleet surgeon as to the necessity of taking lime juice, the responsibility was at once thrown on the captain. The fleet surgeon might, if he had thought proper, have then recorded a written remonstrance as the only other alternative in the case.

9289. I gather from the tenor of the evidence that these officers, unfortunately like everybody else in the expedition, were not impressed with the vital necessity of the use of lime juice. But I was coming to that point, which you have already noticed, that as their remonstrances, which I do not imagine could have been very pointed or very strong, from the evidence which they have both given, had not been attended to on so vital and important a point, did it not then become their bounden duty to take the ultimate measure of writing and requesting, as they were fully entitled to do in such a case, that their letter, on the return of the ships to England, might be forwarded to the commander-in-chief?—That is a question, of course, which officers in the position of Dr. Colan might be disposed to take a very different view of. Some men might, and very properly, have recorded their written opinion as to the necessity of taking lime juice; but other men would, in all probability, consider their duty fully discharged by making the necessary verbal representation to their captain, which, it has been acknowledged, was fully done in this case.

9290. Will you again refer to the evidence which I have called your attention to, and would you be disposed to say that it was fully done?—I think the evidence is, that it was not so fully done as it ought to have been on board the "Discovery"; but it must be remembered that on board the "Discovery" they were bound to adopt the same sledge dietary that was fixed on board the "Alert."

9291. And you consider that on board the "Alert" the duty which I have pointed out, with the exception of the recording, was fully complied with?—I think it was complied with, just as probably very many officers in the service would comply with it, but what may have deterred the surgeon from making a written representation on the subject was, that he must necessarily have seen the inutility of making any written representations when my own suggestions and recommendations, so strong on the subject, were disregarded.

9292. It being of very great importance that no doubt should be left upon what is clearly the duty of an officer so circumstanced; would you be disposed to say that under such circumstances his opinion of the inutility of performing his duty would be a sufficient excuse (I must put it in that light) for not doing it?—I do not think there is any evidence before us to show that there was any neglect of duty in the case, he having made a verbal representation to his captain.

9293. Can you point out for me where this verbal representation is in the evidence?—It is given in evidence by Dr. Colan, and acknowledged by Sir George Nares.

9294. Where?—I think you will find it in answer to Questions 1755 and 1756.

9295. Question 1755 is: "Did you ever express an opinion upon the subject? (A.) Yes. (Q.) Where and

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what? (A.) After I understood that lime juice was not to be sent with the spring sledge parties, I deemed it right and prudent, if not incumbent upon me, to speak to Captain Nares upon the subject of sending it. I did so in his cabin, and was informed by him to the effect that the lime juice could not be sent unless other things, most essential to sledging, were left out. (Q.) Did you discuss the matter any further? (A.) No further. Does that convey the impression to you that he remonstrated strongly, and called Sir George Nares' attention to your suggestions, and pointed out to him the exceeding responsibility which they both incurred in neglecting them?—No; it does not convey to me the idea of a remonstrance having been made; but, as Sir George Nares accepts the responsibility, in his letter dated the 10th of November, in which he says that he alone is responsible for the sledge crews not being supplied with it, I assume that he fully accepted the recommendation made by the surgeon as sufficient under the circumstances.

9296. But it does not appear on this evidence?—I think it is given in Sir George Nares' evidence.

9297. I mean in the evidence to which I am now referring?—There is no remonstrance whatever recorded in Dr. Colan's evidence.

9298. Now, I will refer you to Question 2136: "Then you received no instructions from Sir George Nares to teach the officers in charge of the sledge parties what would be the symptoms should scurvy occur, and what remedies should be applied? (A.) I submitted my sledging instructions to Captain Nares for any emendations or suggestions which he thought proper to give me. (Q.) And were those approved of by him? (A.) Yes; he gave them back to me without any comment. (Q.) Without any corrections or additions? (A.) Without any corrections or additions, or any criticisms of any kind." Now, referring again to these instructions, was it not clearly the duty of the commanding officer to have returned these medical instructions to Dr. Colan, and pointed out to him the omission that scurvy was not mentioned in them, and directed him to give clear and specific instructions to the officers how to deal with scurvy?—If it had occurred to him, I think it would have been desirable.

9299. But ought it not to have occurred to him, with this memorandum of yours supplied to him by the Admiralty for his information?—Certainly it ought to have occurred to him, particularly when there was no lime juice sent to avert scurvy.

9300. (Dr. Donnet.) Although you have stated in evidence that it would have been better had the medical officers of the expedition given a written description of scurvy in their medical instructions afforded to the commanders of the sledge parties, I would wish to know whether this knowledge of scurvy would have been available to these officers, and could anything have been done for these men but to have returned to the ship?—That would have been the proper course when scurvy appeared, to return to ship; but the instructions might have enabled them to detect it.

9301. (Admiral Inglefield.) Were you satisfied with the selection of the men that were sent on this arctic expedition; their ages and general description, I mean?—I could take no exception to the age; the ages, I understand, were about an average of 28, and I think you probably could not well take any exception to that; there may have been some of the men older than I myself might have felt disposed to have chosen. I think the Arctic Committee stated that the age might be from 20 to 30, which would insure, probably, an average of 24 or 25. It is generally known that scurvy is more slow to manifest itself amongst young men; and in making my suggestions, I made it a condition that these men should be men-of-war's men; and, if you get a thoroughly well-developed young sailor, anything above 20, leaving it to the judgment of the medical officer in selecting such a man, I do not know any man more capable of going through a good amount of fatigue. He must be a man-of-war's man, engaged in the service.

9302. (Dr. Fraser.) I wish to ask you, as head of the medical department of the navy, if it be incumbent upon an officer, when he gives his opinion verbally, and finds that it is not attended to, to then record a written opinion?—It is not incumbent on him, unless he thinks it more satisfactory to himself to record his opinion in writing.

The witness withdrew.

Adjourned to Wednesday next, at 12 o'clock.

WEDNESDAY, 28TH FEBRUARY, 1877.

PRESENT:

ADMIRAL SIR JAMES HOPE, G.C.B., in the Chair.

ADMIRAL SIR R. COLLINSON, K.C.B.

VICE-ADMIRAL E. A. INGLEFIELD, C.B., F.R.S.

JAMES J. L. DONNET, ESQ., M.D., Inspector-General of Hospitals and Fleets, R.N.

THOMAS R. FRASER, ESQ., M.D., F.R.S.E.

H. J. VANSITTART NEALE, ESQ., Secretary.

CAPTAIN SIR GEORGE STRONG NARES, R.N., K.C.B., F.R.S., *further examined.*

9303. (The Chairman.) The evidence which has been taken before the Committee has been forwarded to you by our Secretary, and if you have any remarks which you wish to make upon it, we shall be glad to have them?—In my own evidence there are two points which I should like to correct. In answer to Question 229, relating to the ventilation of the lower deck, I did not include the snow house condensers built on the upper deck round each of the hatchways, similar to the plan adopted by Sir Edward Belcher, and alluded to by Dr. Moss in his evidence given before the Committee, at 2266. These condensers, besides lessening the moisture on the lower deck, really acted as ventilators, and proved to be so

good that I increased the size of the porches before each entrance door to as large a size as possible without encroaching on the necessary walking space on the upper deck. In answer to Question 8, relating to the standard for age and height, my statement that I supposed the age was from 25 to 32 should have been from 25 to 31, and the standard for height, which I stated there to be from 5 foot 5 to 5 foot 8, was actually from 5 foot 6 to 5 foot 9. With regard to Questions 2258, 5586, and 7000, with reference to the size of the lower deck of the "Alert," anyone visiting the ship previous to her departure from England would naturally remark on the very small space occupied by the ship's company. This was

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occasioned by the large quantity of provisions and stores necessarily stowed there. Immediately the ship was fixed for the winter these stores were landed, the lower deck was enlarged, and was then at least double the size it was when the ship was visited at Portsmouth. In addition, free communication was kept up at night time, and, when requisite, with the large clear space of the ship amidships abaft the lower deck, which was some 40 feet long. During the cold weather, when the dampness increased on the beams overhead, the bulkhead between the lower deck and this space was removed altogether, and the lower deck then extended from the bulkhead in the bows of the ship to abaft the mainmast. With regard to the impurity of the air on the living deck, I must either question the results of the observations made by Dr. Moss, or of the statements concerning the amount of carbonic acid which would prove objectionable to health. It was my custom to visit the lower deck at about midnight every night, and generally after coming from the outer air. I never once had occasion to complain of the impurity of the air. However difficult it may appear to be theoretically to ventilate the living deck of an arctic ship, it is not more so than when the same ship is engaged elsewhere with a larger crew. If the same test for carbonic acid is repeated on the lower deck of any man-of-war, similar to the "Alert," serving in English waters, a very similar result will, I think, be obtained. I am quite certain that the air on the lower deck of the "Alert" was purer than that on board of the "Resolute"; and, considering the extra size of the space allotted to the men and the means of ventilation, the air must necessarily have been purer than men had ever before enjoyed in arctic service. With regard to the blanched appearance of the ship's company, I find a notice in my journal, on mustering the men on the ice on the 27th of February at divisions: "The chief remark was concerning the very quick disappearance of the pale faces, although two or three of the men are still rather white." In answer to Question 6694, I find that Captain Sherard Osborn supplied his sledge's crew with frozen pickles; and it is remarkable that in Sir Edward Belcher's expedition, his was the only sledge party, with the exception of my own, that suffered from a decidedly severe case of scurvy. In answer to Question 264, in Captain Stephenson's evidence, relating to the entry of men, I would observe, that he could not have intended to imply that I did not examine each man before he was entered. After a personal examination, I entered every man employed in the expedition. When the total list was completed, the men were divided off alternately between the two ships, according to the order in which their names stood on the list. The only exceptions to this division were a few special cases amongst the petty officers. In answer to Question 7891, relating to the supply of minced collops, I have to observe, that when it was found that they were insufficient when issued by themselves, half a ration of minced collops and half of preserved meat was issued, and in that form it was generally taken up by the ship's company. Had they wished it, they might have had all preserved meat. Each mess had always a stock of preserved meat under the mess table belonging to themselves which they had saved, and, although taking up their daily allowance, they used it at their pleasure and at any meal they chose, mixed with the salt meat; so that with each meal, although the issue was not made separately for morning and evening, there was a combination of salt and fresh meat. With regard to the saltiness of the salt meat, special snow-houses were built on the ice after I found that the brine in the salt meat would not freeze at a temperature above zero. The meat being placed for a month in the snow-houses, the brine, unfrozen, was constantly dripping out of the meat, and in that way it did not require so much soaking to remove the salt as it would otherwise have done, and the flavour of the meat was also retained in it. The meat was eaten regularly by

the officers and pronounced very good; but there was a prejudice against it on the lower deck, even after having been treated in this manner; one of the many prejudices which it is quite impossible to remove from sailors living in a body when it has once been started. In answer to Question 9055 in Sir Alexander Armstrong's evidence, it is insinuated that free communication did not exist between the medical officer and myself. I would request permission to state that there is not the slightest foundation for that conclusion. Dr. Colan was my constant and, I may nearly say, daily companion when taking our necessary exercise, and at all times we were in close intercourse with each other. With the one exception, of the carriage of lime juice on the sledges during the month of April, we never differed on any one point. When drawing up his instructions for the travellers he consulted me frequently, asking if I could suggest any further directions. Taking them in conjunction with some practical remarks of my own, which were delivered before the whole crew and officers immediately previous to their starting on the sledges, and which lecture was sent down to the "Discovery" and read to her crew, I considered that all sufficient care had been taken, and all probable cases arranged for. Knowing the immunity from scurvy which all former arctic travellers had enjoyed during the first season, coupled with our good supply of provisions, I never for one moment expected an outbreak of scurvy; and in this matter my confidence as an experienced officer must doubtless have acted on Dr. Colan, and led him to think lighter of the disease than perhaps he would otherwise have done, particularly when he knew that no medical man who had ever previously drawn up sledge instructions had had occasion to allude to the disease. I would further request permission to make a short statement regarding the use of the word "strongly," which is introduced in the sentence, "bearing in mind how strongly the use of lime juice was inculcated." When such a radical change was contemplated in the well known and nicely balanced scale of diet for arctic sledge parties (I allude to No. 11 in the suggestions of Sir Alexander Armstrong), it would have carried greater weight had a reason been given for the contemplated change; for previous to our starting from England the whole evidence as to the healthiness of arctic service quite ignored the fact, so long as we followed the example of our predecessors and worked by their experience, that we need dread the breaking out of scurvy the first season. The idea of mixing lime juice with the pemmican is, I think, excellent; but, knowing the work before us, it is a pity that that plan was not thought of or suggested before we left England, as it might have then been possible to mix it while the pemmican was preparing; afterwards it was not possible, or if it had been, it would have been after all an experiment. It has been suggested that, because former sledge parties escaped scurvy, probably more care was taken of the men by Sir Leopold McClintock than by the officers of the "Alert" and the "Discovery." But Sir Leopold McClintock is not the only man who has made successful journeys; if greater care was formerly taken, which I deny, all the many former arctic travellers must be equally credited. With regard to Sir Alexander Armstrong's book on "Naval Hygiene and Scurvy," I am not quite certain that it was on board of the "Alert"; but if it was sent on board with the suggestions, it was unfortunately mislaid, and I was never able to obtain it; and the other book referred to in his evidence, "A Personal Narrative of the Voyage of the Investigator," being out of print, I have never been able to obtain a copy; in fact it was not supplied with the Admiralty library in consequence of its being unobtainable. With regard to the analysis of samples of lime juice from the arctic ships, in the answer to Question 9109 it is supposed that the lime juice had been exposed to very low temperatures. The fact is, that the lime juice that has been experimented upon has never been frozen. There are many statements relating to the exercise of

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the ship's company, and the "Investigator" has been compared with the "Resolute" in this respect. I have already given evidence about the amount of exercise, and the routine given to the Committee was adhered to; and, owing to the extraordinary calm weather, the crew were only prevented by the wind working and exercising outside the ship for two days throughout the winter. During the severe cold in March, the afternoon work was given up, the men being then busy preparing for the sledging. With regard to the special exercise before sledging, the log of the "Alert" has been referred to. By reference to my journals of the "Resolute," in 1853, and of the "Alert," in 1875, I find that precisely the same number of days of walking and dragging exercise was taken by the crew of the "Alert" as by that of the "Resolute" and the "Intrepid," when the successful journeys were made. In the "Resolute," the special training commenced on the 21st of March, the sledges starting finally on the 4th of April. In the "Alert" the special training commenced on the 20th of March, the sledges starting on the 3rd of April. In the "Alert," advantage was taken of the exercising parties to establish a dépôt of provisions three and a-half miles distant from the ship, the last half-mile of the road entailing as heavy work as the men could expect to meet with on the regular journeys, and, therefore, gave them the very best experience of what was before them. The crews intended to go to the northward away from the land, dragged their boats out over rough ice on two occasions, in order to teach them and prepare them for the extraordinary travelling which they would necessarily have to encounter. The exercise for the dog-sledge commenced on the 19th of February, the excursions being as frequent as the weather allowed, and the sledge started on the 12th of March. In answer to Question 9147, of Sir Alexander Armstrong's evidence, with reference to the weights dragged on the sledges per man, he concludes that the northern party were supposed to journey to the Pole, and states that that task was impossible. I need scarcely observe, that they were never ordered to journey to the Pole. No commander, with the view of the northern ice before him that I had, could ever have issued such an order. Their orders were to proceed to the northward as far as possible, to prove whether or not it was possible to journey with boats over the ice. I may here state that no one yet has ever succeeded in performing a journey with sledges and boats fit for navigation combined, besides Sir Edward Parry, Captain Penny, in 1851, and ourselves. I quite agree now with Sir Alexander Armstrong, that 200 pounds is quite a sufficient weight for any man to drag on a sledge; but when greater weights have been dragged on former occasions, they can scarcely be reduced until experience has proved, as it has now done, that the weight was too much. The weight he alludes to, of 170 pounds per man, as being the utmost dragged by the sledges employed from the "Investigator," can only be arranged for in journeys later in the season, when, as I have already stated, the whole system of travelling is changed. With reference to what I have already stated concerning the care of the sledge crew by the officers, there has been much said about the exhaustion of the men; but surely no one expects such severe work as arctic sledge travelling is not to entail exhaustion. I speak from experience, when I say that in 1853, when I was myself sledging, we journeyed on daily until there was no more work left in us; and the change of the system of travelling, from eleven hours a day to dividing the day into two equal parts of six hours and six hours, was made in order to endeavour to get more work out of us, which it did to such an extent that I decided not to expose my men to such a tax, and fell back to the original plan of the regular day's march; and in this I was merely following what Admiral Richards, and Mechem, and McClintock had already done, who had each of them given up the fashion of travelling six hours and six hours, in consequence of the very severe tax to the

crew. If the sledge crews on former occasions were not exhausted as much as they were on the late occasion, the only difference that I can find is, that they obtained more rest in consequence of the many long forced halts occasioned by the weather, which, as I have already stated, never delayed any of our sledge crews in the "Alert" and the "Discovery." With regard to the warming of an arctic ship, a Sylvester stove, however appropriate for the old sailing ships, can scarcely be used in the present long steam vessels without a very considerable loss of fuel. The two steamers, the "Intrepid" and the "Pioneer," were not heated by the Sylvester stoves, and each of those ships was used as a hospital when the crews of the parent ships became ill, and it was generally considered in the old expeditions that their decks were heated in a preferable manner to those of the "Resolute" and "Assistance." With reference to the remarks of Sir Alexander Armstrong to their Lordships on the scale of diet for the arctic expedition in his report of the 26th of January, 1875, there is allusion made to the insufficient quantity of meat and bread allowed for. I have already given evidence about the quantity of meat which it was possible to consume. The ration of bread as proposed was also too much, and a considerable amount of savings arose. In considering each case of scurvy, Burroughs, the ship's steward of the "Alert," has been stated to have been a man of intemperate habits. That is scarcely the case, although I cannot say that immediately previous to his attack he had not been drinking more than his allowance. With regard to the issue of potatoes to the sledge parties, the ration of two ounces per day was precisely the same amount per week as the men would have received had they remained on board.

9304. (*Admiral Inglefield*). Did you order lime juice to be taken on the sledges only on account of the outbreak of scurvy, or was it always your intention, before you were aware of scurvy occurring, to send it when the weather got warm enough to enable it to be carried without extra fuel?—I would have sent it, most decidedly, if there had been no occasion for the extra fuel, and I am certain that the ration of lime juice for the western party was weighed out and stowed on the main deck several days previous to the outbreak of scurvy.

9305. Bearing upon the same question, and alluding to what you said as to the suggestion of mixing lime juice with pemmican, you stated just now that you thought it would be a good method of administering lime juice, if, from experiment, it was found successful. When that suggestion was made to the Committee, some pemmican, the full ration for a man, with potatoes and lime juice so mixed, was tried in the manner in which it was suggested it should be carried; I think your answer implies that you believed it would have to be mixed on board ship with the pemmican before starting; but, from what I have told you, it would be no mere matter of experiment to mix it with pemmican each day that it was cooked?—No.

9306. And there would be no question that it would be excellent?—Several questions were asked about mixing it with the tea, which I did not agree to; but now I agree fully in its being mixed with the pemmican.

9307. There would be no difficulty in taking it and mixing it with the daily rations?—None whatever.

9308. Have you a copy of the practical remarks which you alluded to, which you made to the ship's company, and of which you sent a copy to the "Discovery"?—I have the rough notes. It was a long lecture.

9309. Could you inform the Committee whether in that lecture you alluded to the outbreak of scurvy, and the symptoms to be observed, and the precautions to be taken?—I never mentioned the word "scurvy," or alluded to it in any way.

9310. Was all the exercise that was taken by the crew of the "Alert" logged, or were there occasion

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when they perhaps went for a run upon the ice, and it may not have been noted?—I observe that on the 22nd and 24th of March, when Lieutenant Aldrich had his crew out, on the first day, and Captain Markham took his boats out over the rough ice to the seaward on the second, that is not logged; those are the only two occasions where there is no mention made in the log.

9311. As a matter of fact, were the men sent to exercise upon the ice whenever they were not otherwise engaged, and as a regular practice?—From the 26th of February the men were generally employed dragging coal from the shore to alongside the ship, and in transporting provisions from the shore on to the upper deck, which gave them very good sledging exercise. On the 13th of March the sledge crews were told off, and the routes for the travellers generally promulgated. On the 19th of March, it being Sunday, instead of mustering by divisions the men mustered by sledge crews for the first time, exercise was commenced the next day and continued daily until the sledges were actually packed alongside ready for starting, on the 31st of March. But the start was put off until the following Monday, the 3rd of April. The sledge crews not out for exercise on any one day were employed in weighing off the provisions and preparing them ready for loading the sledges, it being necessary for each captain of a sledge and the officer to actually weigh out their own provisions, on which their lives depended afterwards.

9312. Practically, the men were exercised in some form or other abundantly every day?—Yes.

9313. Does the amount of savings, compared with the quantity of salt meat which was returned, and the quantity consumed, represent the whole amount that was carried from England, or did you give away any quantity as presents at the settlements, or to the Esquimaux?—A very small quantity of salt meat was given away. In the hurry of the "Discovery's" departure she left several casks of salt beef at Discovery Bay, but the "Alert" left none behind. The salt meat left in the snow houses was put in a harness cask, and not being taken up on the passage home, a small portion became unfit for food and was flung overboard when the warm weather came on.

9314. And is so expended in the log?—Yes, it is so expended.

9315. (*Dr. Fraser.*) You have told us about the enlargement which took place in the space devoted to sleeping in the "Alert," can you also inform us if the return which we have had given to us of the cubic space on the lower deck of the "Alert" represents the space after the enlargement to which you have referred, or not?—From the return I cannot say, as I have no means of calculating; but speaking generally it does not represent the cubic contents of the mess space used by the crew of the "Alert." The cubic contents were greater than is there stated.

9316. It is, I understand, an official return?—Yes, I believe so. Taking the deductions, Dr. Moss's would be right, about 6,000 cubic feet.

9317. I understood you to say that you are not disposed to agree with the results of the chemical analyses, or with the trustworthiness of the deductions which have been drawn from the chemical analyses, showing the quantity of carbonic acid in the atmosphere of the lower deck; is that so?—If those deductions are correct, I think a similar observation made on board a man-of-war, of the size of the "Alert," in the middle of the night in Portsmouth Harbour, would show nearly the same amount of carbonic acid.

9318. In your answer to Question 115, you have said, that before giving us information with reference to the medical history of the abstainers who were on this expedition, you preferred waiting until you could obtain more exact information as to the amount of work which was performed by each man. May I ask you if you have had an opportunity to prepare such a return or table?—By reference to the return of the sledge

parties, I think I could state the amount of work that the abstainers performed, to compare with that of the other men.

9319. I find that the weights of most of the men are given on two occasions in the return to which you have referred, but that several of the weights have not been given; do you think you could procure the omitted weights?—I see that most of the men, whose weight is not given immediately previous to the spring journeys, belonged to the "Discovery," but they wintered on board the "Alert"; and most probably Dr. Colan can give the weights of those men.

9320. You think that they were weighed, at any rate?—Yes, I think that they were weighed; and I might suggest, that, in a matter of this kind, only the officers who took the observations could give very accurate information; but I am not certain that allowance is made for the increased weight of arctic clothing over the clothes worn by the men on joining.

9321. Can you give us some explanation also with reference to your answer to Question 210, as I find that the weights of the equipment of the sledges, and of the articles carried by the sledge parties, have not been given in all the journals?—As I have said before, they have all been sent in to the Admiralty, and those not before the Committee are being printed.

9322. You have referred to a question in Sir Alexander Armstrong's evidence, No. 9147; I dare say you have noticed that Sir Alexander Armstrong himself did not answer the question as it is there put, in so far that he does not tell the Committee what estimate he has formed of the weight dragged by each man in any of the sledging expeditions. I should like to ask you, with regard to that matter, if you can give us your explanation of the weight dragged by the men, for instance, in the northern expedition, because some of the witnesses who have been before us have estimated that weight at 405 pounds per man?—That question is answered in an official letter to the Admiralty. The impossible weight of 405 pounds, as supposed to have been dragged by the northern party, is in consequence of a clerical error in Captain Markham's sledge journal, which is corrected completely in his recapitulation of the weights dragged by his sledge crews, this weight of 405 pounds was noticed by Sir Alexander Armstrong, in a postscript to his report to the Admiralty. On his report being forwarded to me, I sent a complete explanation, which, I suppose, has not been forwarded to him; for I see that he still alludes, in answer to Question 9143, to this same impossible weight. It was never dragged by any crew, and the greatest weight at one time that any of the northern sledgers did drag was less than 240 pounds.

9323. That 405 pounds would represent perhaps the total weight to be transported per man in order to move the whole expedition?—Precisely so; but never by any one man at one time.

9324. I think I understood you to say that you would have considered it advantageous if Sir Alexander Armstrong, in making recommendation or suggestion No. 11, had inculcated the use of lime juice more strongly, and given his reasons also; is that so?—Certainly. In such a matter as arctic work, Sir Alexander Armstrong's opinion and suggestions, although he is the Medical Director-General, would only be received by myself as coming from an arctic officer of experience, unless he also gave me reasons for making such a change.

9325. If the book referred to in paragraph 17 of those suggestions and recommendations entered with great fulness into the question of the reasons for the recommendation contained in paragraph 11, do you not think that he has by that means furnished you with the information which you thought necessary?—He cannot have entered very fully into the subject, as there was no evidence to go upon; but I have not read the work.

9326. Do you mean no evidence to go upon as to the value of lime juice in scurvy?—There was no evidence to go upon as to the value of lime juice to be taken on an arctic sledging party.

9327. I dare say you will agree with me, however, that the question of the value of lime juice in scurvy is, to a very great extent, if not entirely, a medical question, and to be settled by evidence of a medical nature not restricted to experience of any special kind in any special part of the world?—I was merely alluding to the evidence that could have been collected from the presence or absence of lime juice with former sledging parties.

9328. The general consensus of opinion, however, points to this, as we have been told in evidence, that lime juice as a substitute for certain articles of diet is valuable for scurvy wherever scurvy may occur; and, therefore, do you think that it was necessary, in making a recommendation of the description to which we are referring, to judge simply and purely from the restricted evidence derived in the arctic regions?—Not if a new system was being adopted, but when an important change of system is suggested, a good reason should, I think, be given for it.

9329. But you have not seen Sir Alexander Armstrong's book, and, perhaps, you are not aware whether there are any good reasons in that book or not?—No, I am not aware.

9330. You have already told us that you were led to believe that it was not of very great importance to carry this substance, because previous experience had shown that where it was not carried no prominent bad results had followed; is that so?—The previous breakdowns amongst the sledge crews have always been called debility, with the exception of the man in Sherard Osborn's party, and some with Sir Leopold McClintock in the "Fox," who were pronounced to be broken down by scurvy.

9331. You did not find evidence of the necessity for carrying lime juice from what you could gather of the experience of previous expeditions?—No; They had all performed very successful journeys without it, and I expected to do the same.

9332. You are I think now led, however, to believe that there was a larger amount of scorbutic disease in previous expeditions than you had recognised at the time when you were preparing the sledge dietaries?—Most certainly.

9333. Do you think that it is not at any rate possible that those within whose province the study of such a subject falls more especially, may, before then, have been able to recognise those symptoms of scurvy in previous expeditions?—If so it would have been as well had I been informed of it in as pointed a manner as possible.

9334. I wish to ask you whether the suggestions that I understand were prepared by Dr. Carpenter were brought under your notice?—Not more so than the many suggestions contained in the Arctic White Book.

9335. (*Dr. Donnet.*) Lieutenant Aldrich states in answer to question 1329 that for six miles the first day, 3rd April, the weight dragged amounted to 242 lbs., when the men were wearing their duffle coats, and 247 when these coats were put upon the sledges; that on the second day up to the 30th April, a period of twenty-seven days, he double-manned the sledges, and by so doing the actual amount dragged did not exceed from 120 to 125 lbs. per man. Was not a similar plan of double manning adopted in Commander Markham's journey when advancing one sledge at a time?—Precisely the same plan; and I may say that it has always been necessary with loaded sledges to double-man, as it is called, for the first week, until the weights have been reduced to about 200 lbs. per man.

9336. Commander Markham mentions in page 4 of his journal, 11th of April, that Lieutenant Parr with half a dozen men were cutting a road, whilst the remainder, equal to nine men, advanced the sledges singly. Was it attempted to drag the Marco Polo sledge with a weight of 2728 lbs. by nine men?—No; Captain Markham has pointed out the error to me. The context should read, "The men were dragging up the light sledges singly, all hands having previously advanced the heavy sledge."

9337. It has been stated that all the men and the officers assisted to drag the Marco Polo sledge, and it is mentioned in page 2 of Commander Markham's report, that each sledge was drawn by the whole force; was this so?—It must be so, as stated; but probably the lighter sledges were dragged up by fewer men than the heavy one. The heavy one would certainly require the whole force to move it over the heavy road, when fully laden.

9338. Are you of opinion that the extra weights of the northern party were chiefly due to the boats they carried?—Great care is required in loading a sledge. When a boat is placed upon it, instead of the weight being advantageously placed in the middle, some of it projects considerably over each end of the sledge, and by so doing the weight is badly placed and entails more labour on the men than the same weight if distributed in the middle of the sledge; so that a boat is actually more difficult to drag than a corresponding weight.

9339. Do you think that with less than two boats the whole party could have been transported across any great polynia?—That received my very serious consideration before starting the party, and even now, although with our experience, the ice did not break up before their return, I would not take the responsibility of dispatching a sledge party to perform the same journey without a navigable boat being attached to them.

9340. You are acquainted with the history of other sledge journeys, can you give any comparative statement of weights dragged by the sledges in your expedition, and those dragged by former ones?—The weights for sledge parties have varied from about 200 up to 250 lbs. on starting; but all arctic authorities wish to keep the weights down below 200 lbs. if possible. When a navigable boat is added to a sledge, the difficulty of the journey increases enormously. Sir Edward Parry, with about the same weights, made about the same distance daily. Dr. Rae, although such an experienced arctic traveller, in 1849, could not move his boat a single day's journey over the ice until the water made; in fact, although many attempts have been made, no navigable boats have ever been carried, excepting those which I have already mentioned.

9341. In the report of the Arctic Committee, Sir Leopold McClintock suggests that the weight should be 207½ lbs. per man. Captain Austin, in his letter dated 14th July, 1851, gives the average weight as 205 lbs. per man. Is this weight, in your opinion, the average sledge weight that should be carried per man?—Yes, but since these weights were suggested heavier weights have been customary; at the same time I may state that most of the sledges which have dragged these heavier weights were not engaged on a journey in one straightforward direction, but were examining channels and bays in two or three directions away from their main depôt, and therefore the actual weight of 250 lbs. was never on the sledge for more than a few days.

9342. Did you found the weights to be carried on your sledges upon the table compiled from official documents by Captain George Macdougall, master in H.M.S. "Resolute," and which I now show you (*handing the same to the witness*)?—I served in the same expedition with Captain Macdougall, and know that about 240 lbs. was the recognised weight for use at starting.

9343. Do you consider that the exhaustion of the men was due to the heavy nature of the travelling only, and not to weight?—I certainly think that the scurvy was due to the severe work, and not to the weights dragged, and I may mention two journeys that bear reference to this. Dease and Simpson, after spending a winter on the Great Bear Lake, travelling along the north coast of America in 1838, with 12 men, provisioned with pemmican and flour, keep the men in perfect health, apparently, whilst working in the boat. At the extreme of the voyage, Simpson with 7 men, goes on a walking party for 10 days. The men's legs give out immediately, and they return

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to their boat at the end of the time with what I certainly consider now to be severe scurvy; but still those men recover on the sailing boat passage back to the Coppermine, and we hear nothing more about their disease. The same thing happened with Richardson and Rae in 1848. When the men on that diet, with even plenty of fresh meat, are walking and carrying their burdens, they are all lame, in much the same state as our men were, but whilst working quietly in their boats, we hear nothing about any disease.

9344. Can you furnish the Committee with a list showing the days on which double manning was necessary on the "Alert" sledging parties?—It could doubtless be compiled from the sledging journals, but for accuracy it should be done by each commander of the sledge.

9345. From the tenor of your instructions to Commander Markham, dated 3rd April, 1876, I infer that you considered that the object of his journey was rather to ascertain whether a more fully equipped expedition might not at some future period succeed in reaching the North Pole. Am I right in my inference?—Perfectly so.

9346. Did you feel convinced that on this northern journey Commander Markham would fall in with land, and that from this land a basis for a further sledge journey might be obtained?—Had he found land, I intended to put the whole force of the expedition on a journey to the north the second season.

9347. Am I therefore right in supposing that the eastern sledge expedition under Commander Beaumont, and the western one under Commander Aldrich, were intended to see how the land lay, in the hope of throwing most of your force in the second year in the direction most likely to lead to the highest latitude?—Precisely, but in answer to that, perhaps I had better read a statement made by me at the lecture already referred to on board the "Alert," on the 2nd of March, 1876. I then addressed the men thus:—"We have to journey to the westward to trace the shore of this icy sea in whatever direction it may lead us. Should it trend to the southward, we must start off from the land and see what the ice is like, but this we are not fully prepared for until we have more perfect knowledge of its movements. Whatever we do can only be by way of gaining experience as to the possibility of that kind of travelling. If it is possible, we have to undertake it. The 'Discovery's' party will start off to the eastward, and see what the Greenland shores are like. And then we have to determine whether Lady Franklin Sound is a strait or a bay. With all this before us, and knowing the heavy ice we shall meet, I fully expect that the sledging work will be more difficult, and therefore the daily distance accomplished shorter than other expeditions have been able to average over very different ice. Considering all things, I cannot expect that we shall be able to complete the work entrusted to us during the present season; so, as I told you in the hulk at Portsmouth, you must be prepared for a second winter."

9348. The amount of animal life met with by the American expedition whilst wintering in Port Foulke, and the consequent great amount of fresh animal food that could be procured, may have led you to believe, that in your progress further north animal life would abound in an equal proportion; was not this your belief?—I fully expected, in consequence of the musk oxen shot by the crew of the "Polaris," that both the North Greenland party and Captain Aldrich's party would be able to obtain an ample supply of game; but I knew that the northern party over the ice had a very poor chance of doing so.

9349. From your present experience of the arctic seas, and more especially of the higher latitudes of these seas, are you of opinion that the causes which acted upon your sledging parties would be in action with greater power in higher latitudes and some ways in a direct ratio with the advance made towards the pole?—I scarcely think so. The only difference in getting nearer the pole would be the longer absence

of light; and I can scarcely think that that led to the disease breaking out.

9350. Are you, therefore, of opinion from this cause, that the attempt to reach the North Pole should never be made by sledges?—No sledge party will ever reach the North Pole, until we find continuous land extending much nearer to it than what we know of at present.

9351. Might not the attempt to reach the North Pole be successfully made in ships, by waiting for open water?—Navigable water will never be attainable by the Smith Sound route north of Cape Joseph Henry.

9352. Do you think that such an attempt might be made by Plover Land, Wrangell Land, Franz Josef Land, or north of the Parry Islands?—Expeditions sent to any of these places will advance our knowledge considerably; but in any one expedition they will be very fortunate indeed if, in addition to discovering a coast line trending towards the north, they can also reach the pole, which is now 400 miles distant from any known land.

9353. You said in your evidence on the 11th of January, that had there been no sledge travelling there would have been no scurvy; from which I infer that it would not have become developed but for the exhaustion caused by hard work and by the great cold to which they were exposed. Am I right in my inference?—I would not include the cold as producing the scurvy; for other successful journeys have been made in as cold weather.

9354. The nature of the hard work has been laid down in evidence, and has been described as work greater than that undertaken by any antecedent sledge expeditions, and from what you have said you believe that the scurvy was brought out by this excessive fatigue, and subsequent prostration. Do you think that of itself the hard work would have caused scurvy?—Not with men properly dieted; but there is a remarkable case where the "Investigator's" crew are stated to be all down with scurvy, and yet when employed in that state sledging, Sir Robert McClure remarks that the men are better on their return than when they went away.

9355. Was there any special reason given for this circumstance?—No.

9356. For a month previous to the setting out of the principal sledging parties an extra allowance of one ounce of lime juice was directed by you to be added to the daily ration; was this direction given under the impression that by the larger quantity a greater immunity would be afforded against an attack of scurvy?—It may have had a slight effect on my decision, but I issued the double allowance more in consequence of having a quantity on hand; and liking it myself, I knew that everybody else liked the double allowance.

9357. Did you believe that men thus saturated, as you have termed it, would become endowed with a greater power of resistance against scurvy; and was it on this principle that you directed the addition of this extra allowance to the daily ration?—No, I never dreaded scurvy, and I merely gave the extra ration of lime juice because the allowance on board admitted of it.

9358. In the further information on the subject of the outbreak of scurvy which you laid before the Lords Commissioners of the Admiralty, in your letter dated Winchester, 14th December, 1876, you state, with other reasons, why lime juice should not form part of the sledging rations the fact, "that former sledge parties had performed their duties safely and effectually without any such supply." I can readily understand the great importance you attach to the long and safely conducted sledging expeditions of Sir Leopold McClintock, of Admiral Richards, and of the late Captain Meham, and I can appreciate these extraordinary instances of extensive sledge journeys, attended, as they are said to have been, with an immunity from scurvy. But I would ask whether you could establish them as precedents, since from

the high latitudes of your ships, and the greater difficulties your parties encountered, your circumstances differed materially from theirs, and all to your disadvantage?—I can scarcely, even now, consider that our sledge parties were started from a position which could be considered exceptional, except with regard to the actual work that they met with. I scarcely think now that the high latitude made any difference.

9359. Do you establish the journeys, which I have mentioned, as safe precedents to go upon?—I considered so at the time; but I do not now.

9360. The precedent is certainly one that carries weight with it; for in an experience of sledge travelling over 5,107 miles, of which 4,607 were undertaken without any lime juice being carried, the parties under Sir Leopold M'Clintock returned in seeming good health and free from scurvy. But may I ask you, was not this due to the milder circumstances which attended their travelling, to the more steady nature of the work, and to the less degree of enthusiasm which characterised these men?—Their smooth roads were certainly much in their favour; but I think the crews were, as enthusiastic in their work in endeavouring to save life as ours were in undertaking journeys of exploration.

9361. With regard to the immunity said to have been enjoyed by the men forming the sledging parties under the command of the officers of the "Resolute," can you at this distance of time (24 years), recall to your memory whether these men were, on their return, in good health, or whether they were suffering from symptoms which, with your present knowledge, you would recognize as those of scurvy?—I think the man Bailey, who was carried back on my own sledge, was the only case of scurvy, and that every other man after the three days' rest which is always allowed, took to his work at once; in fact, had they not done so, it would have been remarked. But I may refer here to Dr. Bradford's and Captain Austin's evidence of the previous expedition, who, after their return to England, in their evidence before the Arctic Committee, stated that they believed several of the men had scorbutic symptoms, although at the time no mention was made of it. And in the "Resolute's" crew, although at the time the men were not considered to have been much hurt by the travelling, Captain Kellett reports to Sir Edward Belcher, at the end of the second year, that it has knocked them all up.

9362. Do you know whether the same occurred among the crew of the "Intrepid"?—Captain Kellett's statement to Sir Edward Belcher, on the 4th of July, 1854, is to this effect:—"Out of my crew there are 30 men only fit for long service, but of these 15 are officers." That would be out of the 90 men forming the crews of the "Resolute," and the "Intrepid."

9363. Captain Markham stated in evidence that he took with him on his northern journey four ordinary quart beer bottles full of lime juice, and this at your recommendation. Were you under the impression at the time that his party was exposed to greater risk of falling subject to scurvy, and did you recommend this lime juice with the view of its antiscorbutic properties?—Yes; I knew the men would not obtain game, and I thought that some slight scorbutic taint might appear amongst them, but I never dreaded a severe case of scurvy.

9364. Had you any thought of scurvy at the time of its recommendation?—Only so far that I thought a mild case might occur.

9365. This lime juice certainly proved of use, for Captain Markham having, on the 9th of May, become satisfied that his men were suffering from scurvy, issued this lime juice; though, unfortunately, his supply was exhausted nine days after. Was it not a matter of regret that a greater quantity was not sent?—It is, of course, now a matter of very great regret that lime juice was not carried by the sledges; that is to say, if lime juice would have kept off the disease.

9366. Do you think that had a larger quantity of lime juice been sent there might have been a probability of benefiting further these men; or are you of opinion that nothing can be further done for men once stricken down by scurvy but return to the ship as soon as they possibly can?—It is just the question of diet. If they could obtain either lime juice or fresh meat (for even now I lay great stress upon the issuing of fresh meat), then there would be no occasion to bring them to the ship.

9367. But from the difficulties of giving them rest, quiet, shelter, and appropriate diet, whilst men are sledge travelling, would it not have been better for them to have returned to their ship?—One can scarcely expect an outbreak of any disease until the crew would be from 100 miles to 200 miles distant from any relief whatever, and they would have to be dragged back that distance, at all events.

9368. From the evidence which has been afforded to the Committee it appears that the surgeon of the "Alert," in issuing instructions to the officers in command of the sledging parties, acted up to the instructions he had received from the Medical Director-General. Were these instructions submitted for your approval?—Yes; and for any suggestions.

9369. On looking through the instructions supplied by Dr. Colan, I observe that the attention of the officers of the sledging parties is called to several symptoms of scurvy, such as "rheumatic pains," "spitting of blood," "swollen legs and ankles"; and in the concluding remarks of these instructions, to the necessity "of making themselves acquainted with the scurvy-grass and sorrel, in order to make use of them as antiscorbutics." Were you satisfied with these instructions, and did you consider them sufficiently clear and precise?—The symptoms alluded to are common with all sledging parties, and probably that was why he alluded to them expressly; but I am certain they were not received by the officers as in any way referring to an attack of scurvy.

9370. Previous to your departure from England, in the "Alert," you delivered several lectures upon arctic expeditions; am I right in saying so?—Yes.

9371. What was the subject of these particular lectures?—I gave one private lecture to the boys of Winchester College, and afterwards, I gave one at Portsmouth for the benefit of the Seamen and Marines' Orphans, on condition that the men and their friends should be given places; my idea was rather to counteract the feeling amongst them that arctic service was child's play; and I drew as clear a picture as I could of the real nature of the work that they would be likely to undergo, to place before them and before their friends, before they started.

9372. Did these lectures make any allusion to diseases which might occur in the arctic regions, or were they given merely as instructions on general subjects connected with the arctic regions?—They were on general subjects; I must have alluded to frost-bite and snow-blindness, but I certainly did not allude in any way to scurvy.

9373. Did you ever entertain the possibility of an outbreak of scurvy in your expedition?—Not the first season, as long as I took precautions which had before proved successful, but I knew that if the ship was actually three winters in the ice very probably we should have suffered as all others had suffered.

9374. May I ask whether in your experience you have ever met with scurvy occurring in the naval service; I am not now speaking of arctic service?—Never.

9375. May I further ask whether you have heard of scurvy appearing among the crews of royal ships other than arctic ships?—No, never in my own experience.

9376. Do you think that the dietary supplied to the sledge parties which left your ship was a sufficiently ample one for supplying the waste which their hard work entailed?—I never went into the subject in that way, but practically it certainly was sufficient.

9377. Had lime juice been taken in the sledging

Capt. Sir G.
S. Nares,
R.N., K.C.B.,
F.R.S.

28 Feb., 1877.

Capt. Sir G.
S. Nares,
R.N., K.C.B.,
F.R.S.

8 Feb., 1877.

parties, would it, in your opinion, have warded off for a greater period the scurvy which attacked these parties?—I should certainly think so.

9378. What system of walking, training, and sledge dragging training was adopted in the "Resolute"?—On the 7th of February, 1853, the canal from the ship out to seaward was commenced to be gravelled, and that gave ample exercise for the whole crew much the same as the exercise the "Alert's" men had in dragging coal off to the ship. It happened that on the first day's exercising with a party of men out for a walk with Lieutenant Hamilton, he shot a musk ox; then on the following day a sledge party under Lieutenant Mecham was sent out for it; and the remark in my journal, on the 28th of March, is: "One party or another left the ship daily," which would mean that the sledge parties not exercising would be employed as ours were in preparing their provisions and packing the sledges, and I see the sledges were packed alongside ready to start on the 2nd of April. But, generally speaking, the exercise for travelling on board the "Resolute" consisted in walking parties, not dragging sledges.

9379. Had the men of the "Resolute" any amusements or games on the ice?—No; I do not remember any amusements outside the ship.

9380. Had you any in the "Alert"?—None outside the ship.

9381. Did the cold in the month of March prevent sledge training in the late expedition in the "Alert"?—On the 2nd, 3rd and 4th of March I find in my journal it is mentioned that it was too cold for exercise. At this time the dog sledge was training. On the 5th, Sunday, the men at divisions, when standing still for a few minutes, were frequently frost-bitten about the face; those are the few days which I allude to when the afternoon muster on the ice was given up. On the 9th of March it was very fine and calm, and afterwards the weather continued still; therefore the exercise continued as usual.

9382. Are you acquainted with the temperature in

the months of March and April in other expeditions; and can you draw a comparison between them and your expedition?—In my Meteorological Report, I have prepared curves showing the comparative temperatures, and it can be there readily noticed, that as we advance towards the pole, the spring is colder and later than in more southern latitudes.

9383. (*The Chairman.*) In this book on "Naval Hygiene and Scurvy," supplied to you by the Medical Director-General, I observe that there is no special reference to scurvy occurring on sledge expeditions; but as you appear never to have read the book, that circumstance can in no degree have influenced your arrangements?—No.

9384. In your description of the exercise of the people in the "Alert," did I understand you to describe that only which took place subsequent to the 26th of February?—The exercise was continued throughout the winter; but the actual dragging of weights commenced on the 26th of February.

9385. Would you say, on the average, that your people got from five to six hours' exercise daily?—I would sooner limit the statement to about five hours.

9386. On parting company with the "Discovery" in the autumn, did you leave with Captain Stephenson any instructions relative to the wintering of his vessel, and the special equipment of the sledge parties?—I gave Captain Stephenson copies of my notes on the conduct of a vessel in the arctic regions, and equipment of sledge parties; and he had special instructions concerning the conduct of his own vessel; and he had Sir Leopold McClintock's sledging experience in his manuscript.

9387. Putting aside the inconvenience with regard to the weight of the fuel required to melt the lime juice in its frozen state, was there any real difficulty in sending it with the sledge parties?—As far as weight goes, there is no difficulty in carrying lime juice; but there still remains the difficulty of carriage in its present state.

The witness withdrew.

Dr. JOHN ROBERTSON, M.D., Deputy Inspector-General of Hospitals and Fleets, R.N., being prevented by ill-health from attending; furnished what follows in reply to queries put to him by the Committee:—

Mount Albion, Ramsgate, 29th January, 1877.

Letter of
Dr. J. Robert-
son, M.D.,
Dep. Insp.-
Gen., R.N.

In reply to the letter of the Chairman of the Committee on Scurvy of the 20th inst., I regret to say that the state of my health has prevented my replying earlier.

No. 1. The attack of scurvy which appeared in my own person was, in the first instance, caused by my falling into a seal hole whilst out with a sledge party, and afterwards being obliged to be confined to my bed in consequence of the injury sustained by coming in contact with the rough edges of the ice.

No. 2. The confinement in a damp and badly ventilated cabin for some weeks brought on the first symptoms of scurvy in my person.

No. 3. The disease first showed itself by pain in the tendons of the limbs, with great lassitude, loss of appetite, and general depression of spirits. In a few days the gums became dark and spongy, the surface of the body became cold, and in various parts patches of livid and dark colour showed over the limbs and abdomen (these bled at the least touch).

No. 4. My own case was the worst that occurred on board, and my recovery is chiefly attributable to the supply of sea birds, which visited the ships during the months of May and June. The birds were skinned, and cleansed from all fatty matter, to remove the fishy flavour. They were then cut into small portions, and boiled with preserved potatoes, or oatmeal, which made excellent soup. I have a good opinion of preserved potatoes and oatmeal as antiscorbutics. Lime juice, which ought to be our sheet anchor in the prevention and cure of this disease, was found worthless, as supplied to us. On returning home in 1849, I sent

a sample to Sir William Barnett, requesting him to have it analysed, because I had lost confidence in its quality, and in return he wrote to me that it contained only one portion of acid, when it should have contained ten.

No. 5. I believe that moderate exercise in the open air is beneficial to patients suffering from early symptoms of this frightful malady, together with three or four ounces of *good lime juice* daily, with as much mixed nourishing diet as the patient can take. This would prevent the worst character of the disease.

No. 6. Diet has been alluded to above; yet it may be mentioned that in all voyages of this kind the ship should be supplied with plenty of parboiled vegetables, and preserved fruits of all kinds.

No. 7. In arctic sledge travelling, the members of the party should be well clothed with fur jackets, &c., so that the surface of the body be protected from the cold, and the heart's action be the better enabled to supply the extremities with natural heat, &c.

No. 8. There was no regular outbreak of scurvy. When the different sledge parties arrived, a few showed a tendency to the disease, but at this time (June) we had a good daily supply of birds coming in, which were cooked as above stated, consequently we had no death from scurvy.

I remain,
Your obedient humble servant,
JOHN ROBERTSON (b), R.N.,
Surgeon of the "Enterprise" in 1848-49,
in Leopold Harbour, lat. 73.50,
long. 91.20 W.

APPENDIX.

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APPENDIX No. 1.

SAILING ORDERS FOR THE "ALERT."

SIR,

Admiralty, 25th May, 1875.

Her Majesty's Government having determined that an expedition of arctic exploration and discovery should be undertaken, my Lords Commissioners of the Admiralty have been pleased to select you for the command of the said expedition, the scope and primary object of which should be, to attain the highest northern latitude, and, if possible, to reach the North Pole, and from winter quarters to explore the adjacent coasts within the reach of travelling parties, the limits of ship navigation being confined within about the meridians of 20° and 90° west longitude.

2. Her Majesty's ships "Alert" and "Discovery" having been specially fitted out for this service, I am commanded by their Lordships to signify their direction to you, so soon as the said vessels shall be in all respects equipped and ready, to take the "Discovery" under your orders, and put to sea with both vessels, calling at Queenstown to complete with coal, or sending in the "Valorous" (which will accompany the expedition to Disco) for that purpose if more convenient, proceeding thence to Disco, in Davis Strait, and northwards by way of Baffin's Bay and Smith's Sound to carry out the special service of discovery and exploration with which you have been entrusted.

3. Her Majesty's ship "Valorous" will receive on board extra coal and stores, &c., for the expedition, and will be available for towing when requisite. Captain Loftus Jones has been directed to consider himself under your orders temporarily, and after transshipping stores, &c., at Disco, he is to return to Devonport in the "Valorous" in final execution of his orders.

4. The "Alert" and "Discovery" after leaving Disco should proceed to the settlements of Proven and Upernivik for dogs, Esquimaux drivers, &c., and then pass up to Smith Sound in the prosecution of the enterprise, and it will be a question for you to consider whether you would leave a depôt of provisions and a boat at the Carey Islands on passing.

5. Both shores in the vicinity of Capes Isabella and Alexander should be examined in order to select a suitable position for the depôt or relief ship which will, in the event of the expedition remaining in the arctic regions, be dispatched in 1877; but as such a position cannot be absolutely determined on beforehand, and it is necessary to decide where information will be found by any ship which may be subsequently sent out from England, Lyttelton Island, in the opinion of competent authorities, meets all the requirements of a fixed point for rendezvous. Here a conspicuous cairn should be erected; one record placed in the cairn, another laid beside it on the north side, and a third buried 20 feet due north for it. These records should contain proceedings of the voyage, and such information as may be necessary for the commander of the ship to be dispatched in 1877.

6. The ships should then proceed up Smith Sound with all speed, so long as its navigation is not seriously obstructed by ice, a careful scrutiny being made of its shores for places of security for the ships, stopping only to erect cairns on such conspicuous points as may be conveniently landed on. Similar information should be placed at these cairns, and after the same method as described for the cairn on Lyttelton Island. It is, moreover, necessary to be borne in mind that these records of the progress of the expedition and of any change of plans you may have found necessary to make, form an important feature in these instructions.

7. It is desirable that these cairns should not be more than 60 miles apart. By way of illustration, may be named Capes Frazer, Back, and Beechey on the western shore, and Capes Jackson and Bryan on the eastern shore; to these prominent headlands the attention of any searching party would naturally be directed. A small depôt of provisions and a boat might also be advantageously left at one or more of these points, to serve either for exploring parties or to aid in the event of an abandonment of the ships. Timely endeavours should be made to secure anchorage suitable for winter quarters, and every precaution during that rigorous season which your former experience, as well as that of other arctic voyagers, may suggest, is taken for the health and comfort of the officers and crew. Ample supplies have accordingly been furnished to the expedition; and you have been furnished with a memorandum from the Director-General of the Medical Department of the Navy on the subject.

8. The general design of the expedition should be, that while both ships would share as far as possible in the objects of discovery and exploration, one must be so placed that she would not only serve for the crew of the other to fall back upon, but also, that the united crews could, without doubt, escape from her to the relief ship at the entrance of Smith Sound, by means of their sledges and boats over the ice. Consequently, the second ship must not be carried northward of the 82nd parallel: such a position would secure this most important object, and also afford every prospect of exploration into very high latitudes.

9. The eastern or the western shore may be selected for her winter quarters according to circumstances; the advantages of the former are, that animal life has been found to exist there throughout the winter, and that the ship would be favourably placed for exploring the northern coast of Greenland, or adjacent land, in the spring of 1876; on the other hand, if the land is found to be more continuous on the western side, it may afford a counterbalancing advantage in the greater facility and security of communication between the ships, and their co-operation in subsequent operations; this point must, therefore, be left to your judgment to decide; if you should select the western shore, then you should be careful in passing, or subsequently, to place a record on the eastern side of the probable or absolute position of the second ship; and in the absence of any conspicuous cairn, a ship or party visiting the bay wintered in by the "Polaris," in about $81^{\circ} 35'$ north, would naturally seek the position of Hall's grave, where, and at 20 feet due north of it, records would be expected to be found.

10. The captain of the second ship, wherever placed, would follow such instructions as he will have received on parting company, or subsequently, from yourself.

11. It should be a matter for consideration, whether, before parting, you would leave a depôt of some six months of the "Alert's" provisions with your consort, so as to be available for your own crew should they have to retreat, but time and circumstances must govern your decision on this point.

12. Having assured yourself of the safety of your consort, and increased your own crew by such portion of her crew as you may deem necessary to enable you to accomplish a sledging attempt to reach the pole (this being the main feature of the expedition) and also the exploration of your share of the coast line extending northwards, you should, as leader of the expedition, then push on northward, and explore by ship as much of the unknown area as the season and the state of the ice would permit. But it is not contemplated that the two ships should winter at a greater distance apart than about 200 miles; and if you advance with your ship beyond that point in 1875, you should use every endeavour to return within the 200 miles distance; or the case may arise in which it may be even wise to rejoin your consort and unite the forces of both ships for exploration in the spring and summer of 1876.

13. Should the advance ship, after leaving her consort, carry continuous, or nearly continuous land up to a high northern latitude, you should avail yourself of opportunities to land small depôts of provisions at intervals, with cairns and records as already described; and also to deposit at the most northern station a depôt of provisions and a boat for your spring travelling parties.

14. Your own crew having been increased as above referred to, by such portions of the crew of your consort as you may deem necessary, it is expected that you will have at least six strong sledge parties and four dog sledges, with which to commence further exploration in early spring. All these parties should be employed in the first instance to push out the North Pole party (which should be provided with at least one boat) and upon return from this work, some weeks later, the parties for the exploration of the coast lines should be sent out.

15. It must not, however, be lost sight of that, in the absence of continuous land, sledge travelling has never yet been found practicable over any considerable extent of unenclosed frozen sea, although conditions may be found to exist which would enable parties to travel for limited distances by sledge and boat operations combined, and for this purpose the best boats and sledges that can be devised have been supplied.

16. You will be careful to furnish ample instructions to the captain of the "Discovery," especially in regard to the explorations to be undertaken by him during the spring and summer of 1876, should the ships winter apart; and in this event, the first consideration should be, in the autumn of 1875 or early spring of 1876, to ascertain their respective positions; this, unless under very unfavourable conditions, would be probably accomplished by dog parties, without interfering much with the objects of exploration. In connection with this subject, you should bear in mind the necessity of giving such instructions as would govern his proceedings in the event of this proving to be a final separation.

17. It has already been mentioned that the limits of ship navigation should be confined within about the meridians of 20° and 90° west longitude; but even within these limits, the possible contingency of a final separation might arise from some sudden and unforeseen movement of ice from which one or both of the ships could not be extricated; resulting, it may be, in the advanced ship being carried by the southerly drift past the eastern shores of Greenland, supposing Greenland to be an island.

18. It will be impossible therefore to give any positive or detailed instructions for your guidance after quitting your consort, further than that you should use your best endeavours to rejoin her in the navigable season of 1876, and in company with her return to England, providing the spring exploration has been reasonably successful. But in the event of another season being absolutely required to complete a reasonable amount of exploration, still it will be a matter for careful consideration, whether it would not be advisable that the advanced ship should fall back towards her consort from any advanced position she may have wintered at; and, should it still remain doubtful whether a final retreat could be effected, the second ship might not be moved southward to such a position as would secure it.

19. In 1877 you are at full liberty to abandon your ship as early as convenient, if, in your opinion, the explorations of the preceding year had been final, or, if from your experience of the navigable seasons of 1875 and 1876, in your judgment, her escape in 1877 would be doubtful; you should in this case so time this abandonment as to reach the relief ship at the entrance of Smith Sound not later than the first week in September, 1877.

20. In the event of your remaining out in the hope of extricating your own, or it may be both ships, during the summer of 1877, you should consider the propriety of reducing your own or both crews, sending away all that can be spared to the relief ship at Lyttleton Island. In this case, one or both ships would remain out for the winter of 1877, if unable to extricate themselves in the summer of that year, a contingency which is hardly possible.

21. You must, however, bear in mind, that it is not desirable, under any circumstances, that a single ship should be left to winter in the arctic regions. If one ship remains up Smith Sound, a second ship should remain at the rendezvous at its entrance.

22. In the summer of 1877, a relief or dépôt ship will be dispatched to Smith's Sound, and she will be directed, in the first instance, to repair to Lyttleton Island, and then to follow such instructions as you may have deposited in the cairn there. The instructions you will leave for this ship, so far as they need be decided on at present, are, that she is to be found at the rendezvous specified in the records at the cairn, not later than the last week in August, 1877. She will be equipped and fitted for wintering in the Polar Seas, and, in the event of there being no tidings of the expedition nor instructions to the contrary in the records to be found at the rendezvous, you will have named, she will be ordered to pass one winter at that rendezvous, returning to England in the latest part of the navigable season of 1878.

23. If, under the circumstances alluded to in paragraph 20, the retreating parties should arrive at Lyttleton Island in 1878, and find no relief ship there, or no intelligence of her, it will be taken for granted that some unforeseen accident has prevented her reaching Lyttleton Island, and in that case the retreating parties must rely on their own resources for reaching Upnivik, looking out, of course, for the whalers on their fishing grounds, between the months of May and August. The expedition will, in any case, on its return revisit the cairn on Lyttleton Island and leave records.

24. Should the season of 1875 be so unfavourable as to prevent the expedition from penetrating beyond the 79th parallel, it is left to your discretion to decide whether the ships shall winter there or return to England and renew the attempt the following year.

25. Although the expedition entrusted to your charge is one of exploration and discovery, it must be kept in view that detailed surveys are unnecessary. The requirements of hydrography and geography will be provided for if the prominent features and general outline of the shores are sketched in as faithfully as circumstances will admit, and to ensure their recognition by future explorers. In the determination of the astronomical position of the principal points, no doubts should be permitted to exist as to the fidelity of the results that may be arrived at, so as to ensure confidence and respect.

26. Further, as the object of the expedition is for the advancement of science and natural knowledge, the memoranda furnished by the Royal and Royal Geographical Societies of London, at the request of the Admiralty, are supplied for your guidance. The most approved instruments have been furnished to you for the purpose of pursuing

research in the several branches of physical science, and as certain of your officers have been specially instructed in the modes of observing, you will take care to give them every fair opportunity of adding their contributions thereto.

27. You will also receive assistance from the two gentlemen who have been appointed as naturalists to the expedition; and every reasonable facility should be given for the collection and preservation of such specimens of the animal, vegetable, and mineral kingdoms as can be conveniently stowed on board the ship. These specimens are to be considered the property of Her Majesty's Government, and to be at their disposal.

28. In case of any irreparable accident happening to one of the ships, the officers and crew of the disabled vessel are to be removed to the other, and such arrangements must be made as appear to you to be the most expedient and conducive to the objects of the expedition.

29. In the event of the "Alert" being the ship disabled, my Lords hereby authorize you to take command of the "Discovery," and in the event of any fatal accident happening to yourself, Captain Stephenson is hereby authorized to take command of the "Alert," placing the officer next in seniority in command of the "Discovery." Also, in the event of your own inability by sickness or otherwise at any period of this service, to continue to carry these instructions into execution, you are to transfer them to the officer the next in seniority to you employed in the expedition, who is hereby required by their Lordships to execute them in the best manner practicable for the attainment of the objects in view.

30. Every available opportunity is to be taken to communicate your proceedings to me for their Lordships' information.

31. On your arrival in England, you are forthwith to repair to the Admiralty, to lay before their Lordships a full account of your proceedings, having previously received from the officers and all other persons in the expedition the journals or memoranda they may have kept, and the charts, drawings, and observations which they may have made. Such of these journals and documents as may be of an unofficial character will be returned to the writers when no longer required for the public requirements of the expedition.

32. In conclusion, my Lords desire me to state, that having full confidence in your judgment and discretion, and being aware that you are already familiar with Arctic service, they do not deem it necessary to furnish you with more definite instructions than are embraced in the foregoing. With the ample means at your command, you are at liberty to vary the detail according to circumstances, but the main points herein laid down for your guidance should be kept in view, all other objects being subordinate to them.

Captain George S. Nares, R.N.,
H.M.S. "Alert," Portsmouth.

I am, &c.
ROBERT HALL.

APPENDIX No. 2.

SUGGESTIONS AND RECOMMENDATIONS BY SIR ALEXANDER ARMSTRONG, K.C.B., LL.D., F.R.S., MEDICAL DIRECTOR-GENERAL OF THE NAVY, IN REGARD TO THE HEALTH OF THE ARCTIC EXPEDITION.

1. In connection with arctic service there is nothing more important than the selection of officers and men in regard to their physical fitness (and I would also say *moral* fitness where it can be ascertained, as there is no service on which both are more severely taxed); but the remarks to which I have already drawn the attention of the Arctic Committee on this important question appear to be now unnecessary, as the officers and crew have all been entered.

2. Assuming, therefore, that the crews of the ships have been selected as nearly as possible in accordance with my recommendation as to their physical fitness, being of good constitution and sound in all respects, the great object now in view is to maintain them in the same state of health and vigour as when they were entered.

This can only be done on polar service by the use of a liberal dietary, both in animal food and vegetables. I consider the former should consist of 2 lbs. of meat daily, viz.: 1 lb. at dinner, and $\frac{1}{2}$ lb. each at breakfast and supper, with a proportionate

quantity of vegetables and antiscorbutics. I am not aware at present how far this scheme of diet will be carried out, but if acted on I would anticipate little or no impairment of the physical powers ; but on the contrary, with a scale of diet smaller than this I consider that debility of a scorbutic character must ensue, and that at an early period, if the men are much exposed to hard work and intense cold.

Fresh preserved meat should alternate with salt meat each day, with a due quantity of vegetables, and the latter should be such as are of the most succulent character.

I know no vegetable to equal cabbage for such service ; this and Edwards's preserved potato should, in my opinion, form the bulk of the vegetable food.

Pickles of a succulent character should be added to the diet on each day that salt meat is issued, in addition to the ordinary quantity of vegetables, and except as an adjunct, soup should not enter largely into any diet-list for working men as a substitute for meat. Assuming that provision may have been made for giving 2 lbs. of meat to each man daily in the proportions before stated, viz. : 1 lb. at dinner, and $\frac{1}{2}$ lb. each at breakfast and supper, I consider that the breakfast and supper meat should be duly alternated as the dinner meat is from day to day.

3. I attach the greatest possible importance to the daily administration of lemon juice, to commence on the day after the fresh vegetables cease on leaving England ; but this must be carried out on the most rigid principles ; on which it was, without one day's interruption, carried out on board the "Investigator," on my representation of its absolute necessity, viz., by having the aggregate allowance of acid, one ounce per man, with a proportionate quantity of sugar and water mixed in a tub, and drunk on deck in the presence of the officers of the watch.

4. I cannot overrate the importance I attach to the adoption of a similar course in the present expedition, and would urge its being carried out in the strictest manner. By doing so there will be positive evidence that every man in the ship is fortified with an antiscorbutic agent of undoubted efficacy ; whereas in the course usually adopted of sending the lemon juice to the several messes for consumption, there is no evidence whatever of any man taking it, and so valuable an agent should not be left to the whim or caprice of individuals, but rigidly enforced as an element of their safety.

When it may become necessary to recruit men after great or unusual fatigue, either in working a ship through the ice after midnight, or on long marches when travelling, I consider cocoa or tea infinitely preferable to spirits hitherto generally given, and I think the use of the latter should be abandoned on such occasions as far as practicable.

5. When in winter quarters daily exercise should be rigidly enforced on all whose duties do not require them to remain on board ; and the hours between breakfast and dinner, and between dinner and supper, should be entirely devoted to it, or to work as may be necessary outside the ship, so as to ensure about six hours' exercise during the day.

The indoor workers, commonly termed "idlers," will, if permitted, evade exercise ; but it should be enforced on them at periods when they are not required on board.

6. A periodical (monthly) examination of the ships' company after being settled in winter quarters should be carried out, as the earliest signs of debility or scurvy will be readily detected thereby, and immediate measures may be then taken to arrest it.

7. The necessity of keeping the atmosphere of the lower deck as pure as circumstances will permit is obvious ; and the escape of foul air should be promoted to the greatest possible extent ; and the maintenance of as much warmth and dryness as possible is most essential.

8. Under the generally depressing influence of arctic service the importance of promoting hilarity and cheerfulness as sanitary agents is paramount.

9. Men, before they are selected for sledge or travelling parties, should be examined by the medical officers as to the existence of any defect that might possibly render them inefficient, and they should be again examined on their return to the ship.

10. A small supply of such surgical appliances and medicines as might be considered by the senior medical officer of the ship suitable for meeting ordinary slight casualties and illness, with clear and well defined instructions for use, should be placed in charge of the officer commanding the party ; and the petty officers in charge of the sledge should be practically instructed in the use of such appliances before leaving the ship.

11. The use of lemon juice when travelling should be enforced in the same manner as already recommended for the men on board the ship.

12. Snow-blindness should be carefully guarded against in travelling and excursion parties during the spring and summer months ; after the sun reappears veils or neutral-tinted glasses or goggles should be worn to obviate the occurrence of this painful and troublesome affection, a severe attack of which at once renders men for a time inefficient ;

as it comes on as a rule suddenly if the eyes are much exposed to the combined influence of snow and sunshine.

13. Men should at once make known to the officer in command the occurrence of this or any other casualty, however slight the moment they are aware of it. Total exclusion from light by bandaging the eyes, and the application of ice or cold lotions, will be found efficacious in the treatment of snow-blindness.

14. As accidents may frequently occur from the careless use of firearms, a field tourniquet should always be supplied to travelling or shooting parties, and some intelligent person instructed in its use.

15. Frostbites will be of frequent occurrence, chiefly on the exposed parts of the face, hands, and feet. Nothing can be better to restore the circulation in the frozen part than gentle friction with the hand. If the feet or hands are extensively frost-bitten, great care should be taken not to use stimulating applications in the first instance, otherwise acute inflammation, followed perhaps by mortification of the part, is likely to ensue. Should this unfortunately occur then the disease must be treated on general principles.

16. Each ship will be supplied with a few copies of the "Medical and Surgical Handbook," issued from this Department for the use of small ships not carrying medical officers, which, although of too comprehensive a character for Arctic service, yet, as directions are laid down for casualties and slight diseases, I think it will be found of much use to officers on detached service, and where no medical assistance is available.

17. A copy of a book published by me on "Naval Hygiène and Scurvy," embodying my experience of this disease, will also be supplied to each ship, and will, I hope, furnish a suitable guide in its treatment should it unfortunately occur.

18. As a convenient mode of applying ice in cases of snow-blindness, I have directed a supply of goggles, specially made for the purpose, to be furnished to each ship for the use of the travelling parties; also several sets of splints, light, portable, and well adapted to meet the occurrence of casualties when absent from the ship. Both these appliances were invented by the late Surgeon-Major Wyatt, C.B., and will, I hope, prove as useful as I anticipate.

Looking to the fact that this expedition will be one purely of exploration and discovery, and, unlike former ones, will be emancipated from the more trying duties of search, and with a greatly improved dietary, and supplied with all modern improvements suitable to the service, I am of opinion that, if the crews have been carefully selected, and the sanitary rules be strictly enforced, the ships' companies should enjoy an immunity from scurvy, and a freedom from disease hitherto unknown in Arctic expeditions.

A. ARMSTRONG,
Director-General.

In compliance with their Lordships' directions, I beg to forward the accompanying memorandum in regard to the health of the Arctic Expedition for the information of the commanding and medical officers.

A. ARMSTRONG,
Director-General.

30th April, 1875.

Letter from the Secretary to the Admiralty to Admiral Elliot.

SIR,

May 8, 1875.

With reference to an application from Dr. Colan, forwarded by Captain Stephenson on the 11th March last, I am commanded by my Lords Commissioners of the Admiralty to transmit to you, for the information of Captain Nares, Captain Stephenson, and the medical officers of the "Alert" and "Discovery," a copy of a Memorandum, dated 30th ultimo, from the Director-General of the Medical Department of H.M. Navy, containing recommendations and suggestions in regard to the preservation of health of the ships' companies during the forthcoming expedition to the Polar regions.

I am, &c.

ROBERT HALL.

APPENDIX No. 3.

H.M.S. "ALERT."—REPORT OF DIETARY, WITH CHANGES AND REASONS FOR THE SAME.

1. The scale on which the supply of provisions was originally calculated, is Scale A.
2. In consequence of the Medical Director-General's letter, dated 30th April, 1875, a further supply of preserved beef, amounting to 6,372 lbs., was received on board.
3. H.M.S. "Alert" left England on May 29th, 1875, the crew being victualled on fresh meat and vegetables until the 6th June, 1875. On the 7th June, Scale B of victualling was commenced.

Difference between Scales A and B.

4. A quarter of a pound of salt meat issued on preserved meat days for breakfast.
5. The quarter of a pound of preserved meat intended to be issued on salt-meat days not being desired by ship's company.
6. The extra supply of suet and raisins was issued by mistake.
7. On 7th October, 1875, finding that the ration of rhubarb and gooseberries was insufficient for a meal, and that the ship's company were in the habit of saving it up until there was enough, the ration was so increased as to admit of a meal on the days of issue during the winter, with the intention of being again reduced during the summer months, when game would probably be obtainable.
8. From 16th October, 1875, after the return of the autumn travellers, the winter scale of victualling (Scale C) was commenced.

Difference between Scales B and C.

9. Flour for soft bread issued in lieu of biscuit.
Biscuit being issued once every fourth day in lieu of once every third day. Flour being issued three days out of four, instead of two days out of three. This change was rendered necessary in consequence of the large amount of biscuit laid out in the retreating depôts of provisions to the southward, which left the stock remaining on board insufficient for issue according to Scale B.
10. Ration of preserved meat increased at the rate of $\frac{1}{8}$ th lb. daily, in lieu of salt beef, reduced at the rate of $\frac{1}{16}$ th lb. daily, this change being preferred by the ship's company.
11. Increase of ration of bottled fruits explained previously.
12. From 26th October, 1875, the ration of spirit was increased during the winter from half a gill to one gill, except on beer days, when half a gill was issued.
13. On 12th November, 1875, the mistake in issue of suet and raisins was discovered, and the ration reduced.
14. On Christmas Day, an extra issue of flour, fruits, &c., was issued.
15. From 4th March, until the 3rd of April, the day the travellers left the ship, an extra allowance of lime juice (viz., 1 oz.), was issued to those who chose to have it; out of 70 officers and men on board, a daily number of about 17 allowances were not taken up.
16. On the return of any sledge-party to the ship, they received an extra ration of beer, lime juice, coffee, and preserved meat for from two to five days.
17. From 26th May, 1876, in consequence of the outbreak of scurvy, the ration of salt meat was decreased, being issued only once in every four days, preserved meat being issued in lieu, making the ration 3 lbs. of preserved meat and 1 lb. of salt meat in every four days; the rest of the scale of victualling remaining the same.
18. For the same reason, from 16th June, 1876, the ration of lime juice and potatoes was doubled.
19. And from 18th June, 1876, bacon was issued at the rate of $\frac{1}{4}$ lb. daily in lieu of same quantity of salt meat, which enabled the ration of preserved meat to be slightly reduced, the issue of meat then being 5 lbs. of preserved meat, 2 lbs. of bacon, and 1 lb. of pork every eight days. On this allowance, the pork was never taken up by the ship's company and seldom by the officers.
20. From 6th July, having procured fresh meat, the extra issue of lime juice was stopped, except for the sick.

21. After leaving winter quarters on 1st August, the supply of fresh meat being expended, an extra issue of lime juice was served out until arrival in England, to those desirous of having it.

22. When clear of the ice on 8th September, until arrival in England, fruit was issued daily, and the crew were allowed whatever provisions they preferred, and as much as they wanted; the surplus medical comforts were also served out.

23. Under this arrangement the ship's company never applied for salt beef or pork, and consumed on an average 1 lb. of meat daily; viz., 5 lbs. preserved meat and 2 lbs. of bacon per man in seven days.

24. The consumption of vegetables and preserved fruits for six weeks between 9th September and 21st October for 60 men was—

	Preserved Vegetables.			Preserved Fruits.		
	Potatoes.	Carrots.	Onions.	Rhubarb.	Gooseberries.	Pippins.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1st fortnight	120	75	60	45	45	22
2nd ,, 	37	120	108	22½	46	7½
3rd ,, 	165	60	34	0	30	30
Totals	322	255	202	67½	121	59½
Total vegetables ..			779 lbs.	Total fruits .. 248 lbs.		

25. The difference between the adopted Scale C in use during the winter and the unlimited issue is—

	Adopted Scale C.	Unlimited Issue.	Difference.
Fruits	1.33 oz. per man per diem.	1.56 oz. per man per diem.	0.23 oz. increase.
Vegetables	4 oz. „ „	4.94 oz. „ „	0.94 oz. increase.

Sledging Rations, 1876.

	lbs.	oz.
Pemmican	1	0
Biscuit	0	14
Bacon	0	4
Potatoes	0	2
Rum	0	2
Chocolate	0	1
Sugar for ditto	0	½
Tea	0	½
Sugar for ditto	0	1½
Stearine	0	3
Spirits of wine	0	2
Tobacco	0	½
Salt	0	¼
Pepper	0	⅓
Onion powder	0	⅛
Curry paste	0	⅛

1 man per diem.

26. For short sledging journeys later in the season 2 oz. of extra bacon was allowed in lieu of 2 oz. of pemmican, it being preferred by the travellers.

27. All depôts had 5 oz. of stearine and no spirits of wine.

28. All sledges after 7th May took 1 oz. of lime juice and 1 oz. of sugar.

29. Between the 7th June, 1875, and the date of return to England a complete ration of fresh meat was issued on thirty-eight various and uncertain occasions, consisting of looms, ducks, musk ox, &c.

G. S. NARES,

Captain, R.N.

SCALE B.—SCALE OF VICTUALLING FROM 7TH JUNE, 1875, TO 15TH OCTOBER, 1875.

SCALE B.	Weights.	Monday.	Tuesday.	Wednesday.	Thursday.	Friday.	Saturday.	Sunday.	Monday.	Tuesday.	Wednesday.	Thursday.	Friday.	Saturday.	Sunday.	Monday.	Tuesday.	Wednesday.	Thursday.	Friday.	Saturday.	Sunday.
		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Biscuit	lbs.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Flour (for making bread)	lbs.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Preserved meats.	lbs.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Corned beef.	lbs.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Corned pork.	lbs.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Preserved soups.	lbs.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Preserved vegetables.	lbs.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Compressed vegetables	oz.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Flour	oz.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Suet	oz.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Raisins	oz.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Split peas	lbs.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
}																						
for making puddings																						
Spirits	gills	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Celery seed	oz.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Chocolate	oz.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Tea	oz.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Sugar	oz.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Lime juice	oz.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Sugar for lime juice	oz.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Pickles	oz.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
}																						
Mustard																						
Pepper																						
Fruit																						
Sugar for fruit																						
Vinegar																						
Oatmeal																						
Salt																						
Beer																						
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SCALE C.—WINTER SCALE OF VICTUALLING FROM 16TH OCTOBER, 1875, TO 26TH MAY, 1876.

SCALE C.	Weights.	Monday. Tuesday. Wednesday. Thursday. Friday. Saturday. Sunday. Monday. Tuesday. Wednesday. Thursday. Friday. Saturday. Sunday.															
		Monday.	Tuesday.	Wednesday.	Thursday.	Friday.	Saturday.	Sunday.	Monday.	Tuesday.	Wednesday.	Thursday.	Friday.	Saturday.	Sunday.		
Biscuit	lbs.	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Flour (for making bread)	lbs.	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Preserved meats.	lbs.	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Preserved beef	lbs.	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Corned pork	lbs.	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Preserved soups	lbs.	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Preserved vegetables.	lbs.	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Compressed vegetables	lbs.	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Flour	oz.	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Suet	oz.	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Raisins	oz.	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Split peas	lbs.	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
} for making puddings																	
Spirits	gills	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Celery seed	oz.	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Chocolate	oz.	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Tea	oz.	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Sugar	oz.	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Lime juice	oz.	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Sugar for lime juice	oz.	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Pickles	oz.	1	1	1	1	1	1	1	1	1	1	1	1	1	1		

Mustard oz.
 Pepper oz.
 Fruit oz.
 Sugar for fruit oz.
 Vinegar oz.
 Oatmeal oz.
 Salt oz.
 Beer pts.

1 a gill daily.
 1 to every 8 lbs. of peas.
 1 daily.
 1 daily.
 1 daily.
 1 daily.
 1 daily.

1 twice a-week.
 1 twice a-week.
 2 of pippins or 6 of bottled fruit twice a-week.
 As requisite.
 As ordered.
 As requisite.
 Occasionally.

1 man for 28 days.

APPENDIX No. 4.

H.M.S. "ALERT."

Winter Routine.

- A.M.
- 6.45 Call all hands. Lash up and stow hammocks. Call Commander.
 - 7. Watch sweep upper deck, gangways, &c.
 - 7.30 Breakfast.
 - 8.10 Hands clean lower deck and steerage.
 - 9. Hands to clean. Clear up lower deck.
 - 9.15 Both Watches fall in, and "tell off" to duty.
 - 9.45 Inspection of lower deck.
 - 10. In off the ice—Issue lime juice.
 - 10.15 Quarters for Inspection. Prayers—"All hands" fall in and told off to work, outside the ship, if possible.
- P.M.
- 12.45 In off the ice—Clear up decks.
 - 1. Dinner.
 - 2.15 Both Watches fall in, and told off to work (when there is sufficient light).
 - 4. Clear up decks.
 - 4.15 Quarters (on days only when the men have been employed during the afternoon).
 - 4.45 Supper.
 - 8.15 Hang up hammocks (or when Evening School is over).
 - 9. Out lights (or according to the time Classes have been dismissed).
 - 9.15 Rounds.
 - 10. Out Chief Petty Officers' lights.
 - 11. Out Ward Room lights.

On the first Friday in every month, the hammocks will not be lashed up at the usual time, but the bedding will be spread out and aired on the lower deck, remaining hung up in convenient places until 12.30, when the hammocks will be lashed up and stowed.

The Quartermaster of the Watch will have charge of all lights and fires from 11 P.M. until 7 A.M.

He is also responsible for the routine being carried out, reporting to the Commanding Officer the necessary times.

APPENDIX No. 5.

H.M.S. "ALERT."

REGULATIONS FOR THE USE OF THE DRYING ROOM.

Each Mess will have a washing day once a fortnight, on which day all dirty clothes belonging to that Mess are to be washed and hung up to dry; and in addition, the members of that Mess are to be allowed the use of the Drying Room for ablutionary purposes also, as follows:—

No. 1 Mess, on	..	..	..	..	Monday.
No. 2 Mess, on	..	..	..	..	Tuesday.
No. 3 Mess, on	..	..	..	..	Wednesday.
Half the Officers, viz., Captain	..				} .. Thursday.
1st and 3rd Lieutenants, Fleet Surgeon					
Supernumerary Lieutenant, Chaplain, and					
Senior Engineer, on..	..	..	
Chief Petty Officers, on	..	..	..	..	Friday.
No. 4 Mess, on the	..	..	..	..	2nd Monday.
No. 5 Mess, on	..	..	..	..	2nd Tuesday.
No. 6 Mess, on	..	..	..	..	2nd Wednesday.
Remainder of Officers, on	..	..	..	..	2nd Thursday.
W. R. Steward and Officers' Mess linen, on	..				2nd Friday.

On Saturday the Drying Room is only to be used for ablutionary purposes and for drying towels; &c. No clothes are to be hung up on that day or on Sunday, without special permission.

Washing in the Drying Room on the allotted days will be allowed from after breakfast until dinner time, but men will not be excused from morning quarters, only from forenoon exercise. One man taken from the ship's company will have, under the Sergeant, entire charge of the Drying Room, to be relieved weekly, his duties to commence and terminate at 9 A.M. on Monday. He will also attend to all stoves, trim and clean lamps, and draw the daily allowance of oil and coals. During his duty week he will be excused forenoon exercise.

Another man, also taken from the ship's company, will also, in turn, perform the duties of Cook's Mate. It will be his duty to light the fire in the morning, attend generally, at the galley, and will have charge when both cooks are taking their daily exercise. Like the Drying Room man, he will be relieved at 9 A.M. on Monday.

Appendix N° 6.

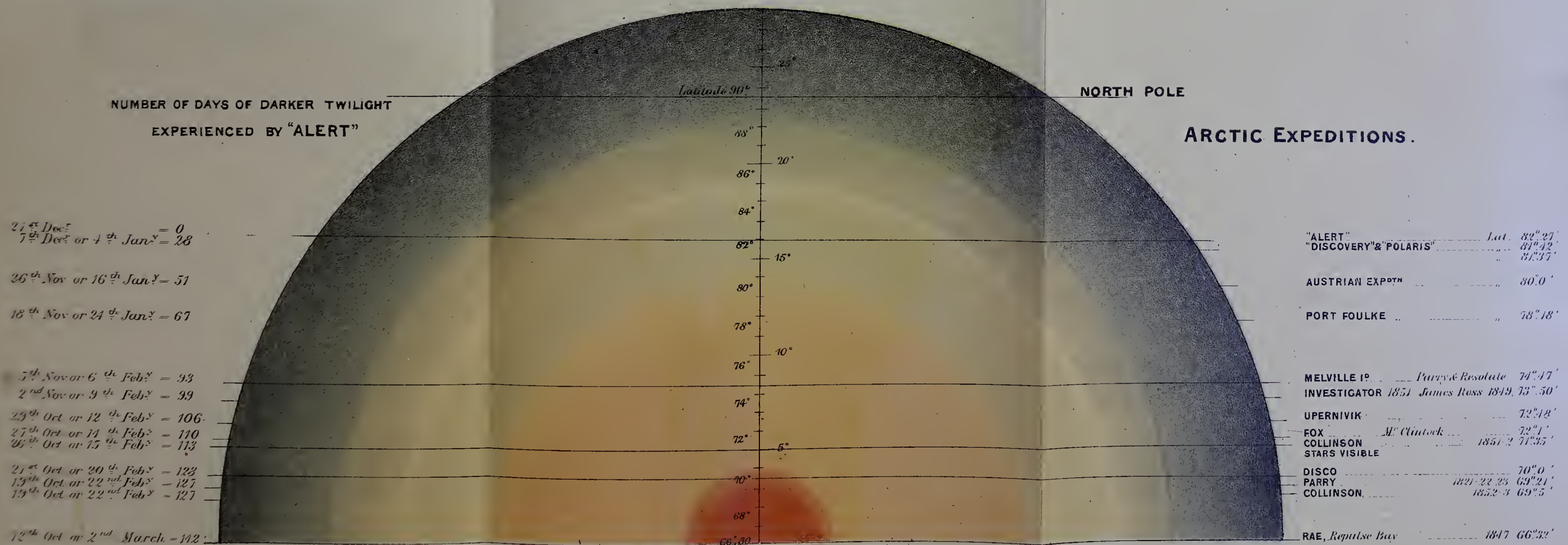
DIAGRAM SHEWING the relative AMOUNT OF TWILIGHT

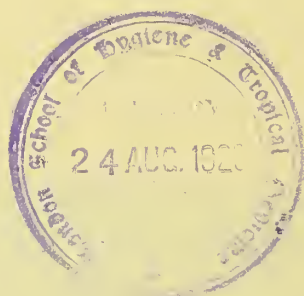
at noon on the shortest day in
different Latitudes North of Arctic Circle.

Observed Limits of Light.

4°	Limit of red rays	That is when the sun is 4°
13°	" " orange "	below the horizon
14°	" " yellow "	
18°	" " green "	Daybreak gun
22°	" " Light "	
5°	Stars 1 st magnitude visible	

G. I. Hares.
Captain. R.N.





APPENDIX No. 7.

PHYSICAL CONDITION OF OFFICERS AND MEN OF H.M.S. "ALERT"
REQUIRED FOR SLEDGING.

REPORT ON PHYSICAL CONDITION.

Commander A. H. Markham	In good health.
Thomas Rawlings, Captain of Forecastle ..	do.
Thomas Jolliffe, Captain Maintop	do.
John Shirley, Stoker	do.
John Radmore, Acting Chief Carpenter's Mate ..	do.
Thomas Simpson, A.B.	do.
Daniel W. Harley, Captain Foretop	do.
Alfred R. Pearce, A.B.	In good health. Has a cicatrix or scar from frost-bite on left great toe. It would be advisable not to send him on an extended sledge journey.

Lieutenant Pelham Aldrich	In good health.
Joshua Good, Boatswain's Mate	do.
Adam Ayles, 2nd Captain Foretop	do.
Thomas Stubbs, Stoker	do.
Elias Hill, Private Royal Marine Light Infantry ..	do.
James Doidge, Captain Foretop	do.
James F. Cane, Armourer	In good health at present, but has suffered a good deal of late from hoarseness and cough. It would be advisable not to send him on an extended journey.

Lieutenant A. C. Parr	In good health.
Edward Lawrence, Captain Forecastle	do.
Reuben Francombe, A.B.	do.
John Hawkins, Cooper	do.
William Maskill, A.B.	do.
George Winstone, A.B.	do.
John Pearson, A.B.	do.
George Porter, Gunner Royal Marine Artillery ..	do.

Lieutenant George Giffard	In good health.
James Berrie, Ice Quartermaster	do.
William Lorimer, A.B.	do.
William Ellard, Private Royal Marine Light Infantry ..	do.
Robert Symons, A.B.	do.
William J. Gore, Stoker	do.
Thomas Stuckberry, Captain Maintop	do.
Henry Mann, Shipwright	do.

NOTES MADE FOR COMMITTEE

William Ferbrache, A.B., joined this sledge on its leaving the ship.

Sent back to the ship sick, 11th April, 1876.

In consequence of this report did not go on long journey, but with Mr. White's supporting sledge.

William Wood, Color Sergeant Royal Marine Light Infantry, joined this sledge on its leaving the ship, also

Henry Mann, Shipwright.

David Mitchell, A.B., joined this sledge in place of Elias Hill, 11th April, 1876.

Died on the sledge, 8th June, 1876.

Sent back to the ship, being too weak, 7th April, 1876.

Thomas Wolley, A.B., joined this sledge on its leaving the ship.
George Cranstone, A.B., joined this sledge in place of James Berrie.

REPORT ON PHYSICAL CONDITION.

Surgeon E. L. Moss, M.D.	..	..	..	In good health.
John Thors, Ice Quartermaster	..	..	..	do.
George Cranstone, A.B...	..	..	..	do.
William Wolley, A.B.	..	..	..	do.
David Mitchell, A.B.	..	..	..	do.
William Wood, Color-Sergeant R.M.	..	..	..	do.
John Hollins, Private R.M.	..	..	..	In good health at present, but is subject to severe and continuous colic, which prostrates him for some days; is a most unsafe man for sledging.

Engineer George White	..	..	..	In good health.
David Deuchars, Ice Quartermaster	..	..	..	do.
Robert Joiner, Leading Stoker	..	..	..	do.
J. W. Hunt, Wardroom Cook	..	..	..	do.
Thomas Smith, Private Royal Marine	..	..	..	do.
Arthur Norris, Carpenter's Crew	..	..	..	do.
James Self, A.B...	..	..	..	In good health, but has lost right great toe from frost-bite, and has scars from same on other toes. It would be advisable not to send him on an extended journey.
William Malley, A.B.	..	..	..	In good health. Has scars on some of the toes from frost-bite. It would be advisable not to send him on an extended journey.

George Bryant, Captain Maintop	..	..	..	In good health.
James Hand, A.B.	..	..	..	do.
Thomas Stuckberry, A.B.	..	..	..	do.
George Stone, A.B.	..	..	..	do.
Alfred Hindle, A.B.	..	..	..	do.
Elijah Rayner, Gunner R.M.A.	..	..	..	do.

NOTES MADE FOR COMMITTEE.

Went to Lieutenant Giffard's sledge 7th April, 1876, in place of Berrie.
 Joined Lieutenant Giffard's sledge on its leaving the ship.
 Went to Lieutenant Aldrich's sledge 11th April, 1876, in place of Hill.
 Joined Lieutenant Aldrich's sledge on its leaving the ship.
 Did not go.

Thomas Chalkley, A.B.	}	Joined this sledge on its leaving the ship.
William Rayner, Gunner R.M.A.		
James Hand, A.B.		
Alfred Hindle, A.B.		

Did not go on long journey, but with George Bryant's supporting sledge.

James F. Cane, Armourer, joined this sledge before its leaving the ship.

Joined Lieutenant Giffard's sledge on its leaving the ship.

Joined Dr. Moss' sledge on its leaving the ship.
 Ditto ditto ditto.

William Malley, A.B., joined this sledge on its leaving the ship.

APPENDIX No. 8.

ABSTRACT OF TEMPERATURES, H.M.S. "ALERT."--G. S. NARES, Captain.

MAXIMUM, MINIMUM, AND MEAN TEMPERATURES.

MONTH	Ward Room, 59 inches above deck			Mainmast, 66 inches above deck			Stokehold, 72 inches above deck			Drying Room, 73 inches above deck			Lower Deck, 71 inches above deck			Lower Deck, 59 inches above deck			Lower Deck, 17 inches above deck			REMARKS
	Maximum	Minimum	Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean	
October ..	55	32	42.4	56	25	42.3	49	15	26.4	71	26	48.4	67	41	52.7	65	37	51.2	56	16	39.7	Observations began October 20th " " ceased May 24th Sledging Parties left April 3rd April and May are not included in the Mean Temperatures for the Winter, which are given below
November	56	29	44.3	58	35	44.8	32	19	26.7	91	38	60.8	68	45	53.5	67	42	52.3	57	31	42	
December	62	39	48.7	56	37	47.3	33	21	27.1	109	48	72.0	61	39	52.0	69	41	51.4	52	26	40.6	
January	58	39	48.7	55	34	45.1	35	22	29.0	109	45	76.8	64	44	54.2	65	45	55.4	56	32	44.5	
February ..	58	40	49.1	58	37	47.2	35	24	29.9	107	43	69.3	64	45	54.3	66	39	53.1	57	28	45.0	
March	60	36	47.0	58	38	47.3	37	23	27.7	103	34	72.6	67	46	55.7	64	42	53.7	55	34	46.9	Drying Room + 109 Stokehold + 15 Lower Deck + 69 Lower Deck (except October) + 26 Ward Room + 62 Ward Room + 29
April	—	—	—	62	42	51.2	32	21	25.8	—	—	—	69	40	56.2	65	40	52.7	62	36	47.3	
May	—	—	—	59	43	49.6	34	26	29.5	—	—	—	66	40	53.3	60	37	50.1	53	31	44.6	

MEAN WINTER TEMPERATURES.

Ward Room	46.7	} 49.8 = Mean Temperature at mean height of 49 inches above deck.
Mainmast ..	..	..	..	45.7
Stokehold ..	..	..	..	27.8
Drying Room	..	..	..	66.7
Lower Deck, 71 in.	..	..	..	53.7
Lower Deck, 59 in.	52.8	}
Lower Deck, 17 in.	..	..	..	43.1

P. ALDRICH,
Commander.

APPENDIX No. 9.

SAILING ORDERS OF "DISCOVERY."

SIR,

Admiralty, 25th May, 1875.

MY Lords Commissioners of the Admiralty having been pleased to select you as second in command of the Special Expedition which has been fitted out for arctic exploration, and having appointed you to the command of Her Majesty's ship "Discovery," I am commanded by their Lordships to signify their direction to you to place yourself under the orders of Captain G. S. Nares, of H.M.S. "Alert," who has been entrusted with the command of the expedition, and to follow his directions for your further proceedings.

2. A copy of the instructions given to Captain Nares is herewith transmitted for your information and guidance.

I am &c.,

ROBERT HALL.

*Captain Henry F. Stephenson, R.N.,
H.M.S. "Discovery," Portsmouth.*

2. Left England on the 29th May, 1875.

3. To the 9th June, 1875, the officers and ship's company were victualled on fresh beef and vegetables in the usual manner.

4. On the 10th June, the victualling, according to the scale mentioned in paragraph 1, was begun.

5. On the 23rd July one ration of looms was made to the officers and ship's company.

6. On the 20th of August one day's fresh mutton was issued.

7. Between the 28th August and the 5th September, 1875, musk-ox beef and salt meat was issued alternately, the ration of each being one pound, but without preserved meat.

8. Between the 6th September and 4th October, the issues of musk-ox beef were irregular, depending mostly on the amount brought on board.

9. Between the 16th October, 1875, and the 29th February, 1876, the period during which the sun was absent, a double allowance of rum was issued, making the ration 1 gill.

10. Between the 4th October and 1st December, the issue of meat was as follows, other articles remained unaltered.

			Salt Pork.	Preserved Meat.	Musk-ox Beef.	Salt Beef.	Preserved Meat.	Musk-ox Beef.
Sunday ..	..	..	1	..	..	..	..	..
Monday ..	..	..	..	$\frac{3}{4}$	..	..	..	..
Tuesday ..	..	..	..	..	$1\frac{1}{2}$	..	..	..
Wednesday ..	..	..	..	..	..	1	..	..
Thursday ..	..	..	..	..	..	..	$\frac{3}{4}$	..
Friday ..	..	..	..	..	..	..	..	$1\frac{1}{2}$
Saturday ..	..	..	1	..	..	..	..	..

11. On the 1st December the scale of victualling at paragraph 1 was resumed.

12. During Christmas week fresh mutton was issued three times; on Christmas Day at $1\frac{1}{2}$ lbs. a man, and on the other days at 1 lb. On Christmas Day the following extra issues were made :—

Coffee	..	..	..	1 oz. a man.
Flour	..	..	..	1 lb. „
Suet	..	..	..	2 oz. „
Raisins	..	..	..	3 oz. „
Bacon	..	..	..	6 oz. „
Pippins	..	..	..	4 oz. „
Sugar	..	..	..	8 oz. „
Ale 1 pint in lieu of half gill of rum.				

13. On the 4th January, 1876, recommenced the issue of musk-ox beef as in paragraph 10, but the ration was reduced to 1 lb., instead of being $1\frac{1}{2}$ lb.

14. On the 4th March, 1876, the musk-ox ration was increased to $1\frac{1}{2}$ lb.

15. On the 28th March, 1876, the issue of musk-ox beef ceased, the supply failing, and the original scale of victualling was again reverted to. On the 30th the preserved meat ration was increased to 1 lb.

16. On the 19th April, 1876, the preserved meat ration was reduced to $\frac{3}{4}$ lb.

17. On the 5th May, 1876, the issue of the meat ration was as follows, other articles remaining unaltered :—

			Preserved Meat.	Salt Pork.	Salt Beef.
Sunday ..	..	..	1	..	..
Monday ..	..	..	1	..	..
Tuesday ..	..	..	..	1	..
Wednesday ..	..	..	1	..	..
Thursday ..	..	..	1	..	..
Friday ..	..	..	..	..	1
Saturday ..	..	..	1	..	..

18. On the 10th May, 1876, the meat ration was as follows :—

				Preserved Meat.	Salt Pork.	Salt Beef.
Sunday .. ..	..	..	..	1 $\frac{1}{4}$	..	..
Monday .. ..	..	..	..	1 $\frac{1}{4}$	..	..
Tuesday .. ..	..	..	..	..	1 $\frac{1}{4}$	..
Wednesday ..	..	..	..	1 $\frac{1}{4}$	..	..
Thursday ..	..	..	..	1 $\frac{1}{4}$	..	..
Friday .. ..	..	..	..	..	..	1 $\frac{1}{4}$
Saturday ..	..	..	..	1 $\frac{1}{4}$	..	..

19. From 12th June, 1876, a ration of flour was issued on soup days, in addition to that on salt-beef days.

20. Between the 17th June and 31st August there were—

28 days on which musk-ox beef was issued.
32 „ „ preserved meat „
16 „ „ salt meat „

During this period many parties were absent from the ship on detached duty, and the victualling was irregular so far as the issues of meat were concerned.

21. On the 7th August, 1876, an extra ration, four ounces of bacon a man a-day was commenced, and continued till arrival in England.

22. On and after the 9th of August, 1876, the allowance of lime juice was doubled, making the ration two ounces.

23. On and after the 18th of August, 1876, double allowance of fruit and sugar was issued, making the ration, fruit four ounces, sugar 1 $\frac{1}{2}$ ounce.

24. On the 1st September, 1876, a ration of seal meat (2 lbs.) was issued to the officers and ship's company.

25. From the 1st September, till our arrival in England, two days' preserved meat to one of salt was issued, as in paragraph 18.

26. On the 20th September, 1876, the allowance of lime juice and sugar was increased to three ounces per man.

27. On and after the 29th September, preserved fruits and sugar were issued every day, at the rate of two ounces a man.

28. The sledging rations during the spring were as follows :—

						One Man for one day.
Preserved Potatoes	..	..	..	..	..	2 Ounces.
Biscuit	..	..	..	..	..	14 Ounces.
Pemmican	..	..	..	..	..	1 Pound.
Bacon	..	..	..	..	..	4 Ounces.
Chocolate	..	..	..	..	..	1 Ounce.
Sugar (for Tea and Cocoa)	..	..	..	..	..	2 Ounces.
Tea	..	..	..	..	..	$\frac{1}{2}$ Ounce.
Pepper	..	..	..	..	..	$\frac{1}{10}$ Ounce.
Salt	..	..	..	..	..	$\frac{1}{8}$ Ounce.
Onion Powder or Curry Paste	..	..	..	..	..	$\frac{1}{8}$ Ounce.
Rum	..	..	..	..	..	$\frac{1}{8}$ Gill.
Tobacco	..	..	..	..	..	$\frac{1}{2}$ Ounce.
Spirits of Wine	..	..	..	..	..	$\frac{1}{2}$ Ounce.
Stearine	..	..	..	..	..	3 Ounces.

H. F. STEPHENSON.

APPENDIX No. 11.

WINTER ROUTINE OF "DISCOVERY."

Week Days.

A.M.

- 6. Turn hands up. Lash up and stow hammocks.
- 6.20 Hands fall in. Tell off duty men for the day.
Clear up upper deck and in ice. Fetch daily allowance of ice.
- 7. Breakfast.
- 8. Watch fall in. Watch below clean lower deck.
- 9. Inspection and prayers. Hands told off for work (outside if possible).
- 11.45 Clear up decks. In off the ice. Lime juice.

P.M.

- 12. Dinner.
- 1.15 Hands fall in. Tell off for work.
- 4.15 Clear up decks. In off the ice. All tools and gear brought inboard.
- 4.30 Supper.
- 5. Watch fall in. Fill up with ice, and prepare gear for fire quarters.
- 5.15 Inspection.
- 8.30 Down hammocks.
- 9. Out lights.
- 9.15 Rounds.

Sundays.

A.M.

- 9. Hands to clean (as ordered).
- 9.30 Clear lower deck.
- 10. Inspection.
- 10.30 Divine service.

P.M.

- 5.30 Evening service.

Mondays.

- P.M. Washing day for one division.

Thursdays.

- P.M. Make and mend clothes.
-

APPENDIX No. 12.

INSTRUCTIONS, MEDICAL AND SURGICAL, FOR SLEDGING OFFICERS OF H.M.S. "DISCOVERY."

IN all cases of illness or injury rest is the great desideratum, and where injury occurs in the extremities, those parts should be supported in such a manner as to favour the return of blood to the trunk.

Abrasions.—Remove the cause, and having cleansed the part, apply a little simple ointment or glycerine on lint or otherwise.

Bleeding from wounds of the extremities, if severe, is to be treated by the application of the tourniquet above the seat of injury. This must never remain screwed up for more than half an hour at one time; it must then be loosened slowly, and if the bleeding recommences, it may be re-tightened for another period; but great care must be taken to keep up the temperature of the limb, or frost-bite may ensue.

If the bleeding is slight, or takes place from the head or trunk, the edges of the wound should be brought in opposition, and a small but firm pad of lint be placed over it, and secured in position by means of a bandage firmly applied so as to act as a compress.

Colic.—Give fifteen (15) drops of wine of opium in a little water, and a second dose in one hour, if necessary. Flannel heated by being wrung out in hot water, or by pouring spirit of wine on and igniting it, may be applied to the abdomen with advantage. If the case is obstinate, a dose of castor oil should be given.

Constipation.—Give two aperient pills.

Diarrhœa.—Give one of the astringent powders, and a second in one hour if required. In cases where the looseness is accompanied by much pain, Dover's powders may be substituted for the astringent powders, but should be followed by a dose of castor oil.

Dislocation of the Shoulder.—Place the patient on his back, extend the arm at right angles to his side, sit on the side of his bed or resting place, place your heel (the boot having been removed) in the armpit, and keeping it well up there, grasp the hand and arms, and bring it down to the side gently but firmly.

Dislocation of the Elbow.—Make the patient sit down, place your foot on the seat; put his arm in such a position so that you can forcibly bend the elbow joint around your knee.

Frost-bites.—The part should be gently rubbed with the hand until sensibility is restored; it should then be smeared with glycerine or the liniment and packed up in cotton wool. Great care should be taken not to disturb the skin or break any blisters. If frost-bites occur on the face, friction and glycerine, but wool and bandages are not required.

If the case is severe, a layer of oiled silk should be placed outside the wool and a bandage gently applied.

Fractures of the Extremities.—The limb is to be cleansed, and, if cold, rubbed gently; it is then to be covered with wool and the splint applied, the whole being kept in position by firm bandaging.

If the ribs are broken, a flannel bandage is to be applied round the chest. The same is to be done in cases of blows to this part.

Retention of Urine.—Give twenty drops of wine of opium immediately; then apply hot flannel to the abdomen, or the patient may sit over the sledge stove in such a manner that the steam from the kettle comes in contact with his person, great care being taken to prevent a chill. If he is inclined to sleep, this should be encouraged.

If the distress is urgent, a catheter must be introduced, previously well greased, and the urine drawn off.

Snow Blindness.—On the first sensation of pain in the eyes the patient must be kept away from the light, and ice goggles, filled with snow, *partially melted*, applied to the eyes. If the pain continues, a drop of wine of opium may be dropped into the eye by means of a quill. When the goggles are removed, an eye shade must be worn. Darkness is imperative.

Sprains.—If hot water is procurable the part should immediately be immersed in it, and in half an hour wiped and a bandage applied. If this cannot be done, friction with liniment, followed by a bandage, must be had recourse to.

BELGRAVE NINNIS, M.D.,
Staff Surgeon.

Sledge Medicines and Appliances.

Box contains—

Ol Ricini, in bottle	8 oz.
Aperient pills, in bottle	4 doz.
Astringent powders	2 doz.
Sp. ammon. arom., in two bottles	2 oz.
Vin. opii, in two bottles	1 oz.
Pulv. Doveris	2 doz.
Glycerine, in two bottles	2 oz.
Ung. cetacei, in oiled silk	2 oz.
Turpentine liniment, one bottle	8 oz.
Ice goggles, fitted with corks	1 pair.
Eye shade	1 pair.
Scissors	1 pair.
Elastic catheter	1
Tourniquet	1
Pins	$\frac{1}{2}$ oz.

A small quantity of strapping, lint, wool, and oiled silk for present use,
likewise a quill.

Parcel contains—

Short expanding splint.	
Lint	$\frac{1}{4}$ lb.
Wadding	$\frac{1}{4}$ lb.
Bandages, flannel	1 lb.
„ cotton (broad, medium, and finger)	3
Oiled silk, $1\frac{1}{2}$ feet square.	

Box—

Canvas bag (painted) to contain box and parcel.

APPENDIX No. 13.

H.M.S. "DISCOVERY."

MEDICAL REPORT ON OFFICERS AND MEN PREVIOUS TO SLEDGING.

*Junior Naval and Military Club, Pall Mall, S.W.,
January 16, 1877.*

SIR,

I HAVE the honour to inform you that, previous to the departure of a sledge, the crew were thoroughly examined by Dr. Coppinger and myself, and none were allowed to start on the journey if they showed any signs of ill-health, or were in any way considered unfit for the work.

I have the honour to be,

SIR,
Your obedient Servant,
BELGRAVE NINNIS, M.D.

*Captain H. F. Stephenson, C.B.,
&c. &c. &c.*

APPENDIX No. 14.

ABSTRACT OF TEMPERATURES OF H.M.S. "DISCOVERY."

Mean Temperatures of the Months whilst the Ship was in Winter Quarters; also the Mean for the Winter.

Month.	Lower Deck.	Ward Room.	External Air.	REMARKS.
1875	Mean.	Mean.	Mean.	
October ..	+49	+49·5	— 9·03	
November ..	+55·5	+53	—17·75	
December ..	+56	+57	—24·5	
1876				
January ..	+52·8	+49	—40·6	
February ..	+51·17	+51	—35·2	
March ..	+50	+47	—37·5	
April ..	+45	+49	—19·84	Men away sledging from this date.
May ..	+46	+54	+ 9·32	
June..	+53·3	+52	+30·18	
July..	+55·5	+53	+36·08	
August ..	+53·6	+55	+36·81	

Maximum, Minimum and Mean for the Winter.

	Mean.	Minimum.	Maximum.	
Lower Deck ..	+52	+33	+69·5	
Ward Room ..	+51	+32	+66	
External Air ..	—27·33	—70·75	+ 2	

Winter Maximum, Minimum, and Mean calculated from October to March, inclusive.

BELGRAVE NINNIS,
Staff Surgeon,
H.M.S. "Discovery."

ABSTRACT OF THE NORTHERN SLEDGE JOURNEY IN THE SPRING OF 1876, BY COMMANDER A. H. MARKHAM.

Journey.	Date. 1876.	Wind.		Temperature.					Statute miles travelled.	Statute miles made good.	Excess travelled over made good.	Number of the Party.				Sledge Parties and Remarks.
		Direction.	Force.	Of Air.		Tent.						Dis- abled.	Able to walk.	Able to drag.	Total.	
				9 A.M.	3 P.M.	8 P.M.	9 P.M.	6 A.M.								
Outward.	April 3	N.W.	1	33	32	31	15	8	6	6	0	0	17	17	H.M. Sledge "Marco Polo."	
	" 4	Calm	0	31	27	35	22	21	11.5	7	4.5	0	17	17	H.M. Sledge "Victoria."	
	" 5	E	1	32	39	41	23	21	14	4.75	0	17	17	Comr. Markham. Thos. Rawlings.		
	" 6	Calm	0	37	31	38	15	—	11.5	6	5.5	0	17	17	Lieut. Parr. Ed. Laurence.	
	" 7	Calm	0	41	38	30	14	15	16.25	5.25	11	0	17	17	Jas. Hawkins. Wm. Maskell.	
	" 8	Calm	0	31	25	29	13	14	11.5	3.5	8	0	17	17	Geo. Winstone. Reub. Francombe.	
	" 9	Calm	0	34	27	30	10	—	15.5	4.75	10.75	0	17	17	John Pearson. George Porter.	
	" 10	Calm	0	32	18	17	7	0	8.25	1.25	7	0	17	17	Thos. Simpson. Alfred Pearce.	
	" 11	S.W.	1	15	3	0	16	16	11.5	3	8.5	0	17	17	John Shirley.	
	" 12	Calm	0	13	8	33	5	18	10.5	1.75	8.75	0	17	17	The Sledges were invariably "double-manned."	
	" 13	N.	1	17	18	27	1	1	10.5	2.75	7.75	0	17	17	The weights to be dragged were never in excess of 236 lbs. per man, until	
	" 14	N.	5	25	27	25	5	15	9.5	2	7.5	0	17	17	the 8th of June, when we were compelled to drag as much as 270 lbs. per man.	
	" 15	N.W.	8	27	34	36	22	15	0	0	0	0	17	17	John Shirley complaining.	
	" 16	N.W.	5 to 1	35	33	32	16	—	8.25	1.75	6.5	1	15	17	George Porter complaining.	
	" 17	Calm	0	24	21	26	5	14	10.5	1.75	8.75	2	15	17	George Porter and John Shirley unable to work.	
	" 18	S.E.	3	21	18	33	7	15	11.5	1.25	10.25	1	15	17	George Porter unable to walk.	
	" 19	Calm	0	Noon	6 P.M.	MID.	MID.	9 A.M.	9.5	1.25	8.25	2	14	17	Alfred Pearce complaining and unable to work. Shirley unable to walk.	
	" 20	N.	2	25	24	35	5	10	9.5	2	7.5	2	14	17	Pearce able to drag.	
	" 21	N.	2 to 5	15	8	14	2	6	9.5	2.5	8.25	2	15	17	Shirley slightly better, and able to walk.	
	" 22	N.W.	4	17	18	24	0	10	10.74	2.75	7.75	1	15	17	Pearce getting worse. Hawkins complaining.	
	" 23	S.E.	4	17	16	17	1	20	10.5	1.75	5.25	1	15	17	Hawkins and Pearce unable to drag.	
	" 24	E.	5	9	22	32	4	2	7	2	4	1	15	17	Francombe complaining.	
	" 25	E.	4	22	19	26	2	16	6	2.75	6	1	14	17	Francombe unable to work.	
	" 26	N.W.	1	17	14	20	8	35	8.75	2	5.5	1	13	17	Francombe unable to walk	
	" 27	N.W.	1	9	11	15	24	28	7.5	1.75	7	1	13	17		
	" 28	Variable	2	9	5	10	24	25	7	2	5	1	13	17		
	" 29	N.W.	5	2	2	4	17	26	0	1.75	7	1	12	17		
	" 30	N.W.	5	2	2	2	24	24	16	0	0	1	12	17		
	May 1	N.W.	3	2	10	10	12	16	10.5	3.25	7.25	1	12	17		
	" 2	N.W.	4	3	10	17	11	19	8.75	1.75	7	1	12	17		
	" 3	N.W.	2	7	2	5	10	14	8.75	1.75	7	1	12	17		
	" 4	Calm	0	4	8	4	13	17	2	0.5	1.5	2	12	17		
" 5	N.W.	1	2	1	7	10	15	4.75	1	3.75	2	12	17			
" 6	S.E.	2	2	11	16	14	27	7	1.25	5.75	3	12	17	Hawkins disabled.		
" 7	Calm	0	2	8	9	15	34	2.75	0.5	2.25	5	12	17	Shirley and Pearce completely disabled.		
" 8	Calm	0	2	4	7	24	36	0	0	0	5	12	17			

Journey.	Date. 1876.	Wind.		Temperature.					Statute Miles Travelled.	Statute Miles made good.	Excess Travelled over made good.	Number of the Party.			Remarks.			
		Direction.	Force.	Of Air.		Inside Tent.						Dis- abled.	Able to walk.	Able to drag.		Total.		
				Noon.	6 P.M.	Mid.	Mid.	9 A.M.										
Outward	May 9	S.E.	1	—	2	—	8	+ 15	+ 35	—	7.75	1.	6.75	5	0	12	17	Thomas Rawlings, William Ferbrache, Thomas Simpson, and George Winstone complaining. Reached the highest northern position. Commenced the homeward journey.
	" 10	S.	1	+	15	—	0	+	36	—	6.5	1.	5.5	5	0	12	17	
	" 11	S.	1	+	4	—	—	—	—	—	0.	2.	0.	5	0	12	17	
	" 12	S.W.	5	+	2	—	2	—	8	—	4.25	2.	2.25	5	0	12	17	
	" 13	S.W.	7	+	3	+	7	+	38	+	10.	1.75	3.25	5	0	12	17	
	" 14	S.W.	1	6 P.M.	Mid.	6 A.M.	6 A.M.	Noon	4 P.M.	7.5	1.25	2.	7.5	5	0	12	17	
	" 15	S.E.	5	+	8	+	10	+	36	—	10.5	2.	8.5	5	0	12	17	
	" 16	N.W.	3	6	8	5	41	—	35	—	11.	2.	9.	5	0	12	17	
	" 17	N.E.	2	7.5	6	6	46	—	44	—	14.	2.75	11.25	5	0	12	17	
	" 18	W.	1	6.5	10	19	35	—	45	—	11.5	2.	9.5	5	0	12	17	
	" 19	N.	1	8	10	21	44	—	45	—	12.5	2.	10.5	5	0	12	17	
	" 20	W.	4	15	20	21	38	—	42	—	11.5	2.	9.5	5	0	12	17	
	" 21	N.	4 to 1	21	23	25	57	—	44	—	11.5	2.	9.5	5	0	12	17	
Homeward	" 22	N.E.	2	25	19	19	52	—	—	7.	1.25	7.	7.	5	0	12	17	The whole party more or less afflicted. Ferbrache unable to drag. Simpson unable to drag. Pearson unable to drag. Rawlings unable to drag. Winstone unable to drag. Lieut. Parr despatched for succour. George Porter (R.M.A.) died. First relief party arrived. John Pearson disabled. Thos. Rawlings, William Ferbrache, and Thomas Simpson dis- abled. Main relief party arrived. Edward Laurence, Daniel Harley, and George Winstone disabled. Commander Markham, John Radmore, Thomas Jolliffe, and William Maskell only able to drag.
	" 23	S.E.	3	18	14	16	52	+	71	8.75	2.	11.75	5	0	12	17		
	" 24	E.	3	10	9	19	40	33	34	8.5	2.	8.5	5	1	11	17		
	" 25	S.W.	3 to 9	13	16	22	31	28	30	0.	0.	0.	8.5	5	1	11	17	
	" 26	S.W.	5 to 9	20	21	25	42	40	38	0.	0.	0.	8.5	5	1	11	17	
	" 27	Variable	3	26	17	22	38	51	48	7.	1.25	2.75	5.75	5	2	10	17	
	" 28	Variable	—	17	19	8	34	55	42	8.75	2.75	2.75	6.	5	2	10	17	
	" 29	Calm	0	6	4	15	36	43	28	8.25	2.75	2.	5.75	5	3	9	17	
	" 30	N.W.	6	20	15	17	29	49	38	7.	2.	2.	5.	5	3	9	17	
	" 31	W.	4 to 9	21	24	25	31	38	36	5.	0.75	0.75	4.25	5	3	9	17	
	June 1	N.W.	5	31	33	34	42	54	48	8.5	2.75	2.	5.75	5	3	9	17	
	" 2	N.W.	4	32	32	31	46	58	54	7.5	2.	1.75	5.5	5	4	8	17	
	" 3	N.W.	2	31	30	30	54	68	70	5.5	1.75	1.	5.75	5	4	8	17	
" 4	Calm	0	32	31	23	56	70	54	7.	1.75	1.	4.5	5	4	8	17		
" 5	N.W.	4 to 9	26	21	20	24	26	41	5.25	2.	2.	5.25	5	4	8	17		
" 6	N.	1	23	24	25	36	70	74	6.5	2.	2.	4.5	5	5	7	17		
" 7	Calm	0	30	33	33	55	58	53	6.	1.75	2.	4.25	5	5	6	16		
" 8	Calm	0	37	36	37	58	54	38	6.	4.	2.	4.	4	5	6	15		
" 9	N.	5	27	25	31	42	48	52	7.	2.75	1.25	3.	4	4	6	15		
" 10	N.W.	4	28	29	27	38	59	56	7.5	7.	4.	0.5	8	1	6	15		
" 11	Calm	0	36	37	33	54	59	56	14.5	13.	7.	1.5	8	1	6	15		
" 12	Calm	0	37	37	37	57	67	56	11.75	10.75	1.	1.	8	1	6	15		
" 13	Calm	0	36	30	30	—	—	—	—	—	—	—	11	0	4	15		
Total Distance travelled											605.5	175.5	430					
Do.											323.75	89.25	235					
Do.											281.75	86.25	195					

2 X 2

Journeys.	Date.	Wind.		Temperature.				Stature miles travelled.	Stature miles made good.	Excess travelled over made good.	Number of the Party.				Sledge Parties and Remarks.
		Direction.	Force.	Of Air.		Inside Tent.					Dis-abled.	Able to walk.	Able to drag.	Total.	
				Noon.	6 P.M.	Midnight.	Midnight.									9 A.M.
From "Alert," along North Coast of Greenland.	May 10	S.E.	1	+ 12°	+ 8°	..	+ 28°	3·94	3·09	·85	..	1	11	12	Paul returned to work, and Hand sent back with No. 3.
	" 11	South	1	+ 12°	+ 10°	..	+ 25°	3·94	3·94	0	..	..	..	..
	" 12	West	3 to 4	+ 14°	+ 1°	..	+ 14°	6·75	5·60	1·15	..	..	..	..
	" 13	Calm	0	+ 14°	+ 8°	..	+ 23°	10·10	10·10	0	..	..	..	..
	" 14	North	3 to 4	+ 11°	+ 1°	..	+ 15°	10·10	8·40	1·70	..	..	..	..
	" 15	West	1	+ 4°	+ 5°	..	+ 31° to 12°	6·20	4·50	1·70	..	..	..	..
	" 16	Calm	0	+ 1°	+ 4°	..	+ 42°	6·20	5·60	·60	..	..	7	7
	" 17	"	0	+ 4°	+ 4°	..	+ 4°	3·50	2·20	1·30	..	..	..	..
	" 18	"	0	+ 5°	+ 4°	..	+ 44°	2·80	2·20	·40	..	..	..	..
	" 19	"	0	+ 19°	+ 14°	..	+ 44°	1·12	1·12	0	..	..	..	..
	" 20	South	2 to 4	+ 8°	+ 14°	..	+ 25°	5·60	0	5·60	..	..	..	..
	" 21	"	2	+ 11°	+ 14°	..	+ 25°	..	..	..	..	..	..	..
Total distance travelled								173·43	125·61	47·32					
Return to Polar's Bay.	" 22	Calm	0	+ 13°	+ 22°	..	+ 51°	7·87	7·87	1	6	7	Jenkins unable to drag. Craig unable to drag.
	" 23	South	1	+ 7°	+ 17°	..	+ 51°	6·75	5·60	1·15	..	2	5	7	
	" 24	S.W.	2 to 4	+ 7°	+ 21°	..	..	6·75	6·75	0	..	2	5	7
	" 25	"	2	+ 7°	+ 19°	..	..	6·75	6·75	0	..	2	5	7
	" 26	W.S.W.	2 to 4	..	+ 14°	..	+ 42°	3·50	3·50	0	..	2	5	7	
	" 27	Calm	0	+ 23°	+ 22°	..	..	9·56	9·56	0	..	2	5	7
	" 28	"	0	+ 22°	+ 30°	..	+ 32°	3·10	3·10	0	..	3	4	7	
	" 29	"	0	..	+ 8°	..	+ 40°	3·50	3·50	0	..	3	4	7	
	" 30	"	0	..	+ 19°	..	..	5·60	4·55	1·15	..	3	4	7
	" 31	"	0	+ 22°	+ 14°	..	..	6·20	5·0	1·20	..	3	4	7
	un.	W.S.W.	2 to 4	+ 21°	+ 19°	..	+ 65°	5·60	4·55	1·05	..	3	4	7	
	" 1	Calm	0	+ 19°	+ 31°	..	+ 72°	4·55	4·55	0	..	3	4	7	
	" 2	S.W.	2	+ 35°	+ 28°	..	+ 55°	2·80	2·22	·58	1	2	4	7	
	" 3	East	1	+ 28°	+ 19°	..	+ 40° to 60°	4·50	1·70	2·80	1	2	4	7	
	" 4	Calm	0	+ 35°	+ 28°	..	+ 45° to 65°	3·50	3·50	0	1	2	4	7	
	" 5	S.W.	1	+ 39°	+ 35°	..	+ 75°	3·09	2·22	·87	1	2	4	7	
	" 6	Calm	0	+ 31°	+ 32°	..	+ 75°	2·80	2·53	·27	2	2	4	7	
	" 7	"	0	+ 31°	+ 33°	..	..	4·22	1·40	2·82	2	2	4	7
	" 8	North	3 to 4	+ 33°	+ 30°	..	+ 51°	3·09	1·97	1·12	2	2	4	7	
	" 9	Calm	0	+ 35°	+ 32°	..	..	5·0	4·55	·45	2	2	4	7
	" 10	"	0	+ 35°	+ 30°	..	..	..	..	..	2	2	4	7
	" 11	"	0	+ 35°	+ 32°	..	..	..	..	..	2	2	4	7
	" 12	"	0	+ 35°	+ 30°	..	..	..	..	..	2	2	4	7
	" 13	"	0	+ 32°	+ 28°	..	..	..	..	..	2	2	4	7
	" 14	"	0	+ 28°	+ 25°	..	..	..	..	..	2	2	4	7
" 15	"	0	+ 28°	+ 30°	..	..	..	..	..	2	2	4	7	

Journeys.	Date.	Wind.		Temperature.				Statute miles travelled.	Statute miles made good.	Excess travelled over made good.	Number of the Party.				Sledge Parties and Remarks.
				Of Air.		Inside Tent.					Dis-abled.	Able to walk.	Able to drag.	Total.	
		Direction.	Force.													Noon.	6 P.M.	Midnight.	9 A.M.
Return to Polaris Bay.	June 14	N.N.W.	3 to 4	+ 35°	+ 30°	+ 25°	..	5.90	1.97	3.93	2	2	3	7	Wilson Dobing unable to drag.
	" 15	West	2 to 4	+ 32°	+ 32°	+ 30°	.. + 72°	6.75	2.22	4.53	2	2	3	7	
	" 16	N.N.E.	2 to 4	+ 38°	+ 33°	+ 28°	..	5.0	1.70	3.30	2	2	3	7	
	" 17	"	2 to 4	+ 32°	+ 35°	+ 26°	..	6.75	2.22	4.53	2	2	3	7	
	" 18	"	4 to 7	+ 26°	+ 21°	..	..	9.0	0	9.0	2	2	3	7
	" 19	"	3 to 7	..	+ 28°	+ 21°	..	4.55	4.55	0	2	2	3	7	Peter Craig and W. Dobing disabled.
	" 20	West	1	+ 25°	+ 35°	+ 28°	..	1.70	1.70	0	2	2	3	7	
	" 21	S.W.	4 to 8	+ 40°	+ 28°	+ 32°	..	2.80	2.80	0	2	2	3	7	
	" 22	"	6 to 7	+ 33°	+ 35°	+ 32°	..	1.97	1.97	0	4	..	3	7	
	" 23	"	2 to 4	+ 38°	+ 29°	+ 28°	6.77	3	7		Joined by Lieut. Rawson, Dr. Copping, and dog sledge. Gray and Frank Jones unable to drag.
	" 24	"	2 to 3	+ 29°	+ 28°	+ 34°	..	7.87	1.10	2.20	4	..	3	7	
	" 25	Calm	0	+ 35°	+ 33°	..	..	6.75	4.55	..	4	..	3	7
	" 26	S.W.	2 to 4	+ 33°	+ 35°	..	..	5.60	5.60	0	4	2	1	7
	" 27	"	2 to 3	+ 29°	+ 31°	7.31	6.75	.56	4	2	1	7	{ This distance was not estimated by day's work, owing to the peculiarity of the travelling, but an estimate of the whole distance formed from the time at work. L. A. B.
	" 28	N.E.	3 to 4	+ 33°	..	..	..	3.94	3.50	.44	4	2	1	7
	" 29	Calm	0	..	..	..	..	..	..	..	..	..	..	..
	" 30	..	..	..	..	..	..	7.31	7.31	0	3	2	1	6
	Total distance travelled							182.98	129.63	53.45					
	Polaris Bay to "Discovery."	July 1	{	No Thermometer.	..	67.50	45.0	22.50
		Aug. 8													
		" 9													
		" 10													
		" 11													
		" 12													
		" 13													
" 14															
" 15															
Total distance travelled																503.71	375.59	133.12

ABSTRACT OF SLEDGE JOURNEYS ALONG NORTH COAST OF GRANT LAND IN THE SPRING OF 1876,
BY LIEUTENANT GIFFARD.

Journeys.	Date.	Wind.		Temperature.						Statute miles travelled.	Statute miles made good.	Excess travelled over made good.	Number of the Party.			Sledge Party and Remarks.	
				Direction.	Force.	Of Air.		Inside Tent.					Dis-abled.	Able to walk.	Able to drag.		Total.
						9 A.M.	2 P.M.	7 P.M.	8 P.M.									8 A.M.
"Alert," along North Coast of Grant Land.	April 3	Calm	0	— 32	— 32	— 32	— 5	—	6.5	5.75	0.75	—	—	8	8	Lieut. Giffard	
	4	"	"	— 22	— 22	— 32	— 12	—	9.9	4.1	5.8	—	—	—	—	James Berrie sent back to Ship, April 7th.	
	5	N.W.	Light air	— 32	— 31	— 41	— 14	—	13.5	4.5	9.0	—	—	—	—	Thomas Stuckberry.	
	6	Calm	0	— 37	— 30	— 35	— 7	+	7.0	3.8	3.2	—	—	—	—	William Lorrimer.	
	7	"	"	— 45	— 32	— 26	— 40	+	8.75	2.9	5.85	—	—	—	—	Robert Symons.	
	8	"	"	— 32	— 26	— 36	—	—	11.3	3.8	7.5	—	—	—	—	William Wolley.	
	9	"	"	— 34	—	— 35	—	—	12.25	4.08	8.17	—	—	—	—	William Gore.	
	10	"	"	— 32	—	—	—	—	3.5	1.2	2.3	—	—	—	—	William Ellard.	
	11	"	"	— 12	—	— 4	— 10	—	7.58	1.17	6.41	—	—	—	—	George Cranstone joined on April 7th.	
	12	"	"	— 10	— 9	— 25	— 14	+	3.5	2.0	1.5	—	—	—	—	The great differences between distance travelled and made good on so many marches was caused by the double-manning.	
	13	"	"	— 20	— 20	— 20	— 7	0	8.3	2.9	5.4	—	—	—	—		
	14	"	"	— 20	— 15	— 20	— 14	+	9.63	3.21	6.42	—	—	—	—		
	15	N.W.	"	— 10	— 18	— 17	— 0	+	7.0	2.3	4.7	—	—	—	—		
	16	N.W. & Calm	2 to 7	— 25	— 25	— 25	— 18	+	11.3	3.8	7.5	—	—	—	—		
	17	Calm	5 to 6—0	— 28	— 30	— 29	— 13	+	10.5	3.5	7.0	—	—	—	—		
	18	"	—	— 15	—	— 22	— 2	+	8.17	2.3	5.87	—	—	—	—		
	19	East	2 to 3	— 20	— 20	— 20	— 20	+	3.5	2.17	1.33	—	—	—	—		
	20	S.E. & Calm	1 to 2—0	— 15	— 5	— 9	— 14	+	7.3	2.62	4.68	—	—	—	—		
	21	N.E. & Calm	1 — 0	— 17	— 19	— 19	— 10	+	7.58	6.4	1.18	—	—	—	—		
	22	N.W.	1	— 17	— 17	— 21	— 10	+	8.17	4.37	3.8	—	—	—	—		
	23	N.W. & E.	1—2 to 3	— 14	— 17	— 23	— 13	+	10.5	3.5	7.	—	—	—	—		
	24	Variable	1 to 2	— 23	— 23	— 25	— 23	+	10.5	3.5	7.	—	—	—	—		
	25	Calm	0	— 23	— 17	— 17	— 23	+	7.0	7.0	0	—	—	—	—		
	Total distance travelled									193.23	80.87	112.36					
	Return to "Alert."	April 26	Calm	0	— 13	— 5	— 12	— 24	+	9.0	9.0	0	—	—	—	—	
27		N.W. & Calm	4 to 5—0	— 9	— 7	— 9	— 24	+	9.9	9.9	0	—	—	—	—		
28		Variable	1	— 5	— 5	— 5	— 27	+	8.17	7.04	1.13	—	—	—	—		
29		W. & Calm	1 to 2—0	— 5	— 5	— 2	— 22	+	7.88	7.88	0	—	—	—	—		
30		N.W.	4 to 5	— 7	— 5	— 5	— 24	+	10.5	6.12	4.38	—	—	—	—		
May 1		N.W.	2 to 5	— 10	— 2	— 5	— 14	+	10.5	7.58	2.92	—	—	—	—		
2		S.W.	1	— 2	— 2	— 6	— 23	+	11.7	10.5	1.2	—	—	—	—		
3	N.W.	1 to 2	— 10	— 5	—	—	—	11.7	11.7	0	—	—	—	—			
Total distance travelled									79.35	69.72	9.63						

ABSTRACT OF SLEDGE JOURNEYS ALONG NORTH COAST OF GRANT LAND, &c.—continued.

Journeys.	Date.	Wind.		Temperature.					Statute miles travelled.	Statute miles made good.	Excess travelled over made good.	Number of Party.				Sledge Party and Remarks.			
		Direction.	Force.	Of Air.		Inside Tent.						Dis-abled.	Able to walk.	Able to drag.	Total.				
				2 A.M.	7 A.M.	9 P.M.	8 P.M.	9 A.M.											
"Alert" to Cape Colan.	May 7	N.W.	2	7	—	—	—	—	—	—	—	—	8	8	William Lorrimer unable to drag. William Lorrimer unable to walk—was left in a snow house with William Wolley to look after him.				
	8	Calm	0	—	6	—	35	+ 27	9.9	0.6	—	—	—	—					
	9	"	"	—	4	—	47	—	8.45	0.85	—	—	—	—					
	10	"	"	—	10	—	41	+ 28	9.6	0	—	1	7	8					
	11	N.W. & S.W.	2-1	10	+ 17	+ 5	+ 20	+ 39	8.5	0.6	—	—	—	—					
	12	N.W.	2 to 4	+ 7	+ 6	+ 2	+ 45	+ 30	6.12	0	1	—	7	8					
	13	"	1	+ 0	+ 5	—	+ 37	—	5.8	2.9	—	—	7	8					
	14	Calm	0	+ 5	+ 5	+ 8	+ 30	+ 42	8.75	0	1	—	6	8					
	15	"	"	—	+ 7	+ 7	+ 35	+ 48	1.2	0	—	One left to look after him	—	—					
	16	S.E.	2 to 6	+ 5	+ 9	+ 3	+ 25	+ 42	11.1	0	—	—	—	—					
	17	N.W. & S.	1 to 2-3 to 4	+ 5	+ 9	+ 8	+ 35	+ 52	Securing Dépôt	—	—	—	—	—					
	Total distance travelled											65.87	60.92	4.95					
	Return to "Alert."	May 18	S.W. & N.W.	1 & 2 to 4	2	9	10	52	18	13.75	0	—	1	—		—	William Wolley unable to drag. William Wolley unable to walk. Lieutenant Giffard. William Malley. Thomas Stuckberry. Robert Symons. William Lorrimer. George Cranstone. William Wolley. William Ellard.		
		19	S.W.	3 to 6	+ 9	+ 15	+ 16	+ 40	+ 35	12.25	0	—	—	6		8			
		20	N.W.	2 to 4	+ 17	+ 15	+ 19	+ 52	+ 36	4.95	0.3	—	—	—		—			
		21	West	1 to 3	+ 19	+ 20	+ 23	+ 44	+ 46	6.4	1.8	—	—	—		—			
		22	N.W.	1	+ 22	+ 24	+ 1	+ 46	+ 50	7.0	1.2	2	—	6		8			
23		Calm	0	+ 19	+ 18	+ 17	+ 46	+ 50	7.58	0.62	—	—	—	—					
24		"	"	+ 15	—	—	—	—	9.3	0	—	—	—	—					
Total distance travelled											65.15	61.23	3.92						

APPENDIX No. 18.

ABSTRACT OF THE WESTERN SLEDGE JOURNEY, SPRING, 1876, BY LIEUTENANT ALDRICH.

Journey.	Date.	Wind.		Temperature.								Statute Miles.			Number of Party.				Remarks.
				Of Air.								Made good.	Travelled.	Excess travelled over made good.	Dis-abled.	Able to walk.	Able to drag.	Total.	
Direction.		Force.	8 A.M.	Noon.	6 P.M.	Mid.	3 A.M.	3 P.M.	Break-fast.	Tent.									
										Tea.	At Night.								
Outward.	April 3	Calm	0	—	—31	—33	—	—	—	—	—	—	7.	—	—	—	16	No. 1.	
	4	"	Lt. air	—31	—22	—32	—	—	—	—	—	—	10.40	4.65	—	—	—	Lieut. Aldrich.	
	5	Calm, N.W.	—	—32	—31	—41	—	—	—	—	—	—	9.20	4.60	—	1	15	Jos. Good.	
	6	Calm	0	—35	—37	—	—	—	—	—	—	—	11.50	9.20	—	2	14	Wm. Wood.	
	7	"	—	—42	—	—26	—	—	—	—	—	—	9.20	4.60	—	1	14	Jas. Doidge.	
	8	"	—	—37	—	—36	—	—	—	—	—	—	13.80	9.20	—	—	15	Adam Aytes.	
	9	"	—	—34	—	—35	—	—	—	—	—	—	13.80	9.20	—	—	—	Thos. Stubbs.	
	10	"	—	—32	—	—30	—	—	—	—	—	—	8.06	6.91	—	—	—	Henry Mann.	
	11	Calm, N.W.	Lt. air	—12	—	—4	—	—	—	—	+20	—	14.97	11.52	—	—	—	Elias Hill.	
	12	Calm, North	1	—10	—	—25	—	—	—	+20	+15	—	8.06	4.61	—	—	16	No. 2.	
	13	Calm	0	—20	—	—20	—	—	—	+18	—	—	10.39	6.94	—	—	—	Lieut. Giffard.	
	14	Calm, South	2	—20	—15	—20	—	—	—	—	+12	—	10.39	6.94	—	—	—	Jas. Berrie.	
	15	N.W.	2.6	—10	—	—17	—	—	—	—	—10	—	8.63	5.75	—	—	—	Thos. Stuckberry.	
	16	N.W., Calm	5	—26	—	—25	—	—	—	—	+6	—	12.09	8.06	—	—	—	Wm. Lorrimer.	
	17	"	Lt. air	—28	—30	—29	—	—	—	+15	+15	—	10.39	6.94	—	—	—	Robert Symons.	
	18	Calm	—	—15	—	—20	—	—	—	+24	+15	—	8.06	5.47	—	—	—	Wm. Wolley.	
	19	Calm, East	2.3	—20	—	—20	—	—	—	+8	+8	—	2.88	8.64	5.76	—	—	Wm. Gore.	
	20	"	Lt. air	—15	—5	—9	—	—	—	+20	—	—	2.88	8.64	5.76	—	—	Wm. Ellard.	
	21	"	"	—17	—	—19	—	—	—	+24	+10	—	6.33	—	—	—	—		
	22	N.W., Calm	2.3	—17	—	—21	—	—	—	+14	—	—	4.61	13.82	9.21	—	—		
	23	"	Lt. air	—14	—	—23	—	—	—	+12	—	—	3.45	10.39	6.94	—	—		
	24	East, Calm	1.2	—23	—	—25	—	—	—	—	—	—	3.45	10.35	6.90	—	—		
	25	Calm	0	—23	—	—	—	—	—	—	+21	—	4.03	4.03	—	—	8	No. 2 left for the ship.	
	26	"	0	—21	—	—1	—	—	—	+30	—	—	2.88	8.64	5.76	—	—		
	27	"	0	—15	—15	—	—	—	—	+33	—	—	4.60	13.82	9.22	—	—		
	28	"	0	—15	—	—15	—	—	—	+33	Sum.	—	3.45	10.35	6.90	—	—		
	29	"	0	—15	—8	—	—	—	—	—	+40	—	3.45	10.35	6.90	—	—		
	30	East, N.W.	Lt. air 3.5	+4	—	—	+8	—	—	+27	—	—	4.03	4.03	—	—	—		

ABSTRACT OF THE WESTERN SLEDGE JOURNEY, &c.—continued.

Journey.	Date.	Wind.		Temperature.								Statute Miles.			Number of Party.			Remarks.		
		Direction.	Force.	Of Air.						Break- fast.	Tent.		Travelled.	Made good.	Excess travelled over made good.	Dis- abled.	Able to walk.		Able to drag.	Total.
				8 A.M.	Noon.	6 P.M.	Mid.	3 A.M.	3 P.M.		Tea.	At Night.								
Outward.	May 1	N.W.	4.6	—	—	—	—	—	—	—	—	—	—	6.33	6.33	—	—	—	—	—
	2	"	1.4	—	—	—	—	—	—	—	—	—	—	9.21	9.21	—	—	—	—	—
	3	Calm, East	1.2	—	—	—	—	—	—	—	—	—	—	10.39	10.39	—	—	—	—	—
	4	East, West	1.3	—	—	—	—	—	—	—	—	—	—	8.64	8.64	—	—	—	—	—
	5	S.W.	2.3	—	—	—	—	—	—	—	—	—	—	5.76	7.48	1.72	—	—	—	—
	6	Calm	0	—	—	—	—	—	—	—	—	—	—	10.39	10.39	—	—	—	—	—
	7	East, West	1.3	—	—	—	—	—	—	—	—	—	—	8.92	8.92	—	—	—	—	—
	8	Calm	0	—	—	—	—	—	—	—	—	—	—	9.79	9.79	—	—	—	—	—
	9	West	Lt. air	—	—	—	—	—	—	—	—	—	—	10.39	10.39	—	—	—	—	—
	10	Calm, West	4.5	—	—	—	—	—	—	—	—	—	—	7.48	7.48	—	—	—	—	—
	11	S.W., West	5.6	+ 13	—	—	—	—	—	—	—	—	—	8.06	8.06	—	—	—	—	—
	12	West, W.S.W.	4.6	+ 12	—	—	—	—	—	—	—	—	—	8.06	8.06	—	—	—	—	—
	13	S.W.	1.4	—	—	—	—	—	—	—	—	—	—	8.06	8.06	—	—	—	—	—
	14	Calm	0	+ 5	—	—	—	—	—	—	—	—	—	10.39	10.39	—	—	—	—	—
	15	"	—	—	—	—	—	—	—	—	—	—	—	10.94	10.94	—	—	—	—	—
	16	Calm, N.E.	7.8	—	+ 12	+ 12	—	—	—	—	—	—	—	8.06	8.06	—	—	—	—	—
Homeward.	17	N.E., W.	Lt. air	—	+ 10	+ 10	—	—	+ 12	—	—	—	—	4.61	4.61	—	—	—	7	8
	18	Calm	0	—	+ 14	—	—	—	—	—	—	—	—	10.94	10.94	—	—	—	—	—
	19	West, Calm	Lt. air	—	—	—	—	—	+ 8	+ 14	+ 26	—	—	10.94	10.94	—	—	—	—	—
	20	Calm	0	+ 10	—	—	—	—	—	—	—	—	—	6.91	6.91	—	—	—	—	—
	21	"	—	+ 15	—	+ 16	—	—	—	—	—	—	—	10.39	10.39	—	—	—	—	—
	22	S.W., N.E.	Lt. air	+ 18	—	+ 18	—	—	—	—	—	—	—	10.39	10.39	—	—	—	—	—
	23	N.E.	3.4	+ 20	—	+ 10	—	—	—	—	—	—	—	10.39	10.39	—	—	—	—	—
	24	Calm, N.E.	2.6	+ 10	—	+ 12	—	—	—	—	—	—	—	8.06	8.06	—	—	—	—	—
	25	Calm	1	+ 15	—	+ 15	—	—	—	—	—	—	—	10.94	10.94	—	—	—	—	—
	26	S.W.	—	—	—	—	—	—	—	—	—	—	—	13.82	13.82	—	—	—	—	—
	27	"	6.8	+ 20	—	—	—	—	—	—	—	—	—	8.06	8.06	—	—	—	—	—
	28	South	6.1	+ 18	—	+ 11	—	—	—	—	—	—	—	6.33	6.33	—	—	—	—	—
	29	Calm	2	+ 8	—	—	—	—	—	—	—	—	—	5.76	5.76	—	—	—	—	—
	30	"	0	—	—	—	—	—	—	—	—	—	—	7.48	7.48	—	—	—	—	—
	31	Calm, S.W.	3	+ 13	—	+ 19	—	—	+ 14	—	—	—	—	4.61	4.61	—	—	—	—	—
	1	S.W.	3	—	—	+ 20	—	—	—	—	—	—	—	3.45	3.45	—	—	—	—	—
2	S.W., Calm	1	+ 32	—	+ 34	—	—	—	—	—	—	—	—	—	—	—	—	—	—	

ABSTRACT OF THE WESTERN SLEDGE JOURNEY, &c.—continued.

Journey.	Date.	Wind.		Temperature.								Statute Miles.			Number of Party.				Remarks.		
		Direction.	Force.	Of Air.				Tent.				Travelled.	Made good.	Excess travelled over made good.	Dis-abled.	Able to walk.	Able to drag.	Total.			
				8 A.M.	Noon.	6 P.M.	Mid.	3 A.M.	3 P.M.	B ^r a. f st.	Tea.									At Night.	
Homeward.	June 3	Calm	0	+ 33	—	+ 33	—	—	—	—	—	—	—	4.03	10.40	6.37	—	3	5	8	Wood, Stubbs, Mann—unable to drag. Mann did some hauling. All hands did more or less. Wood, Stubbs--unable to drag. Mann unable to drag.

APPENDIX No. 19.

MEDICAL INSTRUCTIONS FOR SLEDGING OFFICERS, GIVEN TO
OFFICERS OF H.M.S. "ALERT."

ARTICLES REQUIRED TO HOLD MEDICINES.

1st. A circular tin, 7 inches in height, by $5\frac{3}{4}$ in diameter, furnished with a cap, handle, and diaphragm cut out for bottles. A 6 lb. preserved mutton or beef tin, with part of another as a cap, answers this purpose very well. For fear of accidents, the principal medicines are in duplicate bottles.

2nd. A rectangular tin, 20 inches long, 7 broad, and $6\frac{1}{2}$ deep.*

CONTENTS OF MEDICINE TINS.

Aromatic Spirit of Ammonia (sal volatile) in two phial bottles	3 ounces.
Laudanum or Chlorodyne (poisons), in two phial bottles ..	$1\frac{1}{2}$ "
Or, Opium Powder (poison), in 30 papers, of $\frac{1}{2}$ a grain each ..	15 grains.
Dover's Powder (poison), in 12 papers, of 10 grains each ..	2 drachms.
Chalk and Ginger Powder, in 32 papers, of 15 grains each ..	1 ounce.
Sugar of Lead (poison), in 30 powders, of 2 grains each ..	1 drachm.
Glycerine, in phial bottle for the pocket	$1\frac{1}{2}$ ounce.
Carbolic Oil (poison), in phial bottle	1 ounce.
Turpentine Liniment, in bottle	6 ounces.
Glycerine Ointment, in oiled silk and paper	6 "
Collodion, in phial bottle	2 "
Carbolic Plaster	1 ounce.
Purgative Pills, 5 grains each, in phial bottle or tin box ..	4 drachms.
Calico Bandages, 3 in number	$3\frac{1}{2}$ ounces.
Flannel bandages, 2 in number	6 "
Lint	6 "
Oiled Silk	1 ounce.
Sponge	1 "
Pins, in paper	1 drachm.
Expanding Splints, 2 in number, with carbolized tow. ..	20 ounces.
Tow (fine), or Cotton Wool	$3\frac{1}{2}$ "
Catheter, 1 in number	$1\frac{1}{2}$ drachm.
Tourniquet, 1 in number	$6\frac{1}{2}$ ounces.
Truss, or Bandage, with pad	$3\frac{1}{2}$ "
Lancet, 1 in number	1 drachm.
Quill, 1 in number	10 grains.
Persian Gauze	$1\frac{1}{2}$ ounce.
Eye Shades, 2 to 6 in number	$\frac{1}{2}$ oz. to $1\frac{1}{2}$ oz.
Small Splint, 1 in number	1 ounce.
Flannel Ice Goggles, in metal case or card-board ..	17 ounces.
Sticking Plaster	6 ounces.
Tape	1 ounce.
Mustard, in paper	4 ounces.
Paper, about	1 ounce.

Aromatic Spirit of Ammonia (Sal Volatile).

Dose, 20 to 60 drops in half a gill of water or warm tea. Good in over-fatigue, lassitude, fainting, or giddiness.

Laudanum, or Opium Powders (Poisons).

Dose, 10 or 15 to 20 drops, in half a gill of rum and water, or water alone, or half a grain placed on the tongue, and swallowed. Good in colic, cramp of the stomach, diarrhoea, and sleeplessness. The same may be said of chlorodyne as of laudanum.

* A wooden bottle, 20 inches by $8\frac{1}{2}$ by 6, was afterwards substituted for the whole, some bottles were smaller according to the number of men, and contained less.

Wine of Opium (Poison).

For external use, 2 to 3 drops to be dropped into the eye from a quill. Good in snow-blindness. This medicine may be used internally, in lieu of, and in the same doses as laudanum.

Gregory's Powder.

Dose, a teaspoonful mixed (first as a paste), in half a gill of rum and water, or water alone. Good in cramps of the stomach, colic, looseness of the bowels, or as a mild purgative.

Dover's Powder (Poison).

Dose, 10 grains (one of the powders), in half a gill of water or warm tea. Good given at bedtime, when a cold is felt coming on, in cold shivering, and rheumatic pains.

Chalk and Ginger Powder.

Dose, 15 grains, one of the powders stirred well in half a gill of rum and water, or water alone. Good in the later stages of diarrhoea, or in acidity of the stomach or heartburn.

Sugar of Lead (Poison).

For external use, 2 grains (one of the powders), to be dissolved in one ounce and a half of water (a quantity which fills the bottle *specially* provided for the purpose). Good in snow-blindness, or any superficial inflammation of the eye, and for newly-sprained and swollen joints.

Turpentine Liniment.

For external use. Good (rubbed in) in sprains, chronic swellings of the joints, and (applied on flannel), in sore throat, soreness of the chest, and pain in the belly.

Carbolic Oil (Poison).

For external use. Good spread on lint for ulcers, and deep-seated and sloughing frost-bite.

Glycerine Ointment, or Glycerine.

For external use. Good rubbed on the skin to prevent frost-bite, and for superficial frost-bite with unbroken skin.

Simple, or White Ointment.

For external use. Good in chapped skin, and (spread on lint) in superficial and blistered frost-bites, for sores, for smearing on sore eyelids at bedtime, and for lubricating a catheter before introduction.

Carbolic Plaster.

Good for covering ulcers and sores.

Collodion.

May be used to prevent frost-bite, for chapped skin, and slight cuts.

Be very careful in measuring out and using the medicines marked "Poison."

Colic, or Cramp in the Stomach.

If pain in the belly be complained of, give 15 (fifteen) drops of laudanum or chlorodyne, or one of the opium powders in a tablespoonful of water; follow this in half an hour with half a gill of warm rum with water. If hot water be procurable, stupe or foment the abdomen for half an hour in a flannel wrung out of it in another cloth, every five minutes, or apply drinking bottle with hot water, and covered with flannel and blanket, or apply mustard poultice for 20 minutes, or rub in gently some turpentine liniment. If none of these are at hand, saturate a piece of flannel 6 inches square, in spirits of wine, methylated spirit, or concentrated rum, set on fire; when flannel is hot, blow out, flame, and apply the cloth to abdomen every five minutes, for four or five times. In two hours after giving the laudanum, administer a teaspoonful of Gregory's mixture in half a gill of warm tea.

Diarrhoea, or Looseness of the Bowels.

Give a good teaspoonful of Gregory's powder in half a gill of water. In two hours after, administer 15 (fifteen) drops of laudanum, or one of the opium powders, in a

tablespoonful of water, having in the meanwhile applied a mustard poultice to the abdomen, or rubbed in turpentine liniment. In another two hours, give a chalk and ginger powder, 15 (fifteen) grains in half a gill of water, stirring the mustard well. Repeat this powder every 6 (six) hours for 4 (four) times, and give what light nourishing food can be had. If possible, allow the patient some rest in bed, and cause him to wear a flannel belt round the waist.

Constipation or Costiveness.

Give one of the purgative pills as a mild, and two as a stronger aperient, or administer a teaspoonful of Gregory's powder in half a gill of warm tea.

Difficulty in Making Water, or Retention of Urine.

When a man complains of not having made water for some hours, after repeated efforts to do so, give him a warm cup of tea, and let him smoke his pipe, stupe, as for colic, the fore part of the abdomen, as also the perineum, or crutch, or if in want of water, use the flannel heated by lighted spirits. Then let the patient try and pass water, either standing, or on all fours, *unobserved*. Should no relief ensue, give 15 (fifteen) or 20 (twenty) drops of laudanum in a warm cup of tea, or one of the opium powders, and again stupe, after which place the man in his sleeping bag in the tent, and let him remain for a few hours. If no water be made in the meantime, and great distress and pain be complained of, and a hard round tumour be felt at the lower part of the abdomen, try stuping once more. If all be unsuccessful, introduce the catheter. First make the instrument warm by drawing it through the hand, and smear it with simple ointment. Place the man standing with his back against the tent pole, or other support, or lying on the flat of his back. Take penis in left hand, draw it slightly forward, then with the right hand introduce the catheter *very gently*, keeping the point pressed along the upper surface of the urethra or passage. If obstruction be met with, press a little more firmly. If no progress be made, draw back instrument a little, and try again, *coaxing* it, as it were, along; when passed for about $8\frac{1}{2}$ or 9 inches the water will flow. Let it do so till bladder be emptied. Then gently withdraw the catheter. Do not give any spirits in cases of this kind. It should be well remembered that the catheter is a last resource, and should not be used if any chance appear of the urine coming away.

Fainting, Over-fatigue, Headache, and Giddiness.

Give 30 (thirty) or 40 (forty) drops of aromatic spirit of ammonia in half a gill of water or warm tea. If man faint lay him flat on his back, with the head in a line with the shoulders, loosen everything round his throat, apply a little sal volatile with the fingers to the nostrils. When he revives give him 40 (forty) drops of the same in half a gill of rum and water.

Snow-Blindness.

Most apt to occur in spring and summer travelling, may be attended with much pain. If the complaint be slight, put one powder (2 grains) of sugar of lead in the bottle provided for it, fill up with water, and when dissolved, bathe the eye with the solution frequently for 15 minutes. Do this three times a day, or in lieu use a strong infusion of tea. After bathing fill socket of eye with cotton wool, and place a bandage over it round the head. If affection be severe, bathe first with warm water, then with lead lotion, and drop with quill between the lids, at bedtime, two drops of wine of opium. Afterwards apply the cotton compress, or in lieu of the bathing, if the temperature of the snow be not below 32° Fah., fill the flannel ice goggles with the latter, and apply them to the eyes, when the snow will dissolve gradually. Be very careful never to use snow under 32° . Give a purgative pill occasionally, and smear a little simple ointment between the lids at night, when wine of opium be not used. Cause the eyeshades* to be worn if the compress cannot be borne. As preventive measures it may be advisable to travel at night when possible, to wear snow spectacles or crape, to blacken round the eyelids with charcoal, and to change back the leading men on the drag-ropes frequently.

Frost-bite.

Let it be well borne in mind that such may occur unawares, and also on a sudden rise of temperature. The officer should frequently ask his men if they feel any loss of sensation anywhere, and advise them to apply to him at once if they do. If no sensation, or a painful tingling be felt, *immediately* examine the part, in the tent (if it be

* As many eyeshades as may be needed can be made with a little stiff canvas and Persian gauze.

legs or feet). If the skin exhibit either a dull purplish red, or livid colour, or a tallowy, pale, or a gelid or frozen white appearance, frost-bite has taken place. The object will be to restore the circulation of the blood in the part without allowing *too much* reaction to ensue, which might result in mortification or gangrene, therefore, *too much* warmth must be avoided. In slight cases, keep the warm hand on the part, after which apply a little glycerine ointment, and bind on a little cotton wool, as such place is very apt to be attacked again. Should the frost-bite be severe and extensive, let several men apply their warm hands, and after a time *gently* rub the part, or, if there be bladders or vesication, the surrounding parts; if success result, dress as before. Give the men 30 (thirty) drops of sal volatile in a tablespoonful of water. Another plan is to raise the temperature by snow to just under 32° Fah., and to keep it at that by adding occasionally small pieces of colder snow, and rub this gently in, or plunge the injured part into cold water for some time when circulation is established; dress with glycerine ointment and wool. Should these means fail to restore the part, and gangrene ensue, dress with carbolic oil and carbolic plaster, lightly bandaging over them, or wrap in wool or tow, and if it be a lower limb, place the man on sledge, clothe him well, and give him what nourishing food is procurable. In superficial frost-bites glycerine ointment may be applied, or simple ointment. As a preventive measure, glycerine or glycerine ointment might be rubbed into or applied to exposed parts of skin.

In very cold weather the face cloth should be worn, and night travelling adopted when possible, as such would allow of the men sleeping in the higher temperature of the daytime, rendering them less liable to be frostbitten during sleep. The edges of drinking vessels should be rubbed with the mittened hand before being applied to the lips.*

Coma, or Insensibility from Cold.

Get the unconscious man into the tent, strip him and rub him all over with dry flannels; when he revives give him 30 (thirty) drops of sal volatile in a tablespoonful of water. Put on his clothes, and let him rest in his sleeping bag for a few hours, during which time give him a warm cup of tea.

Common Cold, with Running from the Nose.

Apply mustard poultice to the chest for 20 minutes, and at bedtime give a Dover's powder (10 grains) in half a gill of warm tea or rum and water.

Inflammatory Affections of the Chest.

If a man complains of feverishness, with oppression of breathing, and either a dull or sharp pain in chest on drawing a long breath, if there be cough with frothy, or sticky, white, rusty, or bloody-coloured mucus, give him a teaspoonful of Gregory's powder in half a gill of water, and apply a mustard poultice every 6 hours for three times, 15 minutes at a time, to part of chest where pain is complained of, putting each successive poultice *near*, but not *on* the site of its predecessor. If weakness attend a case that exhibits sticky or rusty-coloured sputa, give the patient as much nourishing food (little and often) as possible, and occasionally a teaspoonful of rum in water, letting him have rest. Do not administer opium in these cases.

Rheumatic Pains.

Rub in turpentine liniment, and give a Dover's powder (10 grains), in half a gill of rum and water, at bedtime.

Sore Throat.

Apply round the neck some flannel, soaked in front with turpentine liniment.

Internal Pains, sometimes accompanied with Spitting of Blood.

Men with such will be fit for little, owing to weakness, and they will rarely be found to improve. Clothe them well, give them what nourishing food can be had, and ease them off work as much as possible.

Fish Poisoning.

If men who have lately eaten fish exhibit great depression, with vomiting and purging, redness and swelling of the face, give each a dessert spoonful of mustard in a gill of warm water, and assist the vomiting thus caused with copious draughts of warm water. When the stomach is quiet, give half a gill of rum and water, and in two

* In some cases great bladders may form after reaction sets in, and yet no great evil will result.

hours a teaspoonful of Gregory's powder. Adopt the same treatment from partaking of putrid meat, or the liver of any animal.

Rupture.

If a man complain of hidden pain in or near his groin, and if on examination a small swelling be found which gives an impulse to the fingers on coughing, get him on his back with the knees drawn up, so that the bowels press somewhat upward, then, with the forefinger and thumb of each hand, *gently knead*, as it were, and *coax* the protruding bowel back into the abdomen. If unsuccessful, give 15 (fifteen) or 20 (twenty) drops of laudanum or wine of opium in a little warm tea, or an opium powder, and in an hour manipulate as before. If failure again ensue, apply, in flannel, some snow just under 32° Fah., to the swelling for a few minutes, and make another attempt at reduction. When bowel is back, put on a truss, or bandage with pad, but on no account put on either if bowel will not return.

Swollen Legs and Ankles.

More common in autumn, late spring, and summer travelling than at other times, when the snow is harder and drier. Rub gently with turpentine liniment, and afterwards bandage. Preventive measures: Never sleep in damp socks, foot cloths, or mocassins, but change to dry socks on going to bed, putting damp gear under the blanket to dry. A little rum or spirits of wine, in the proportion of a teaspoonful of spirit to a gill of tepid water, may be usefully applied to damp and cold feet, afterwards well rubbing with a dry towel.

Sprains.

If recent, bathe with warm water, if procurable, or dissolve sugar of lead as directed for snow blindness; apply it on lint, and lightly bandage. In a couple of days gently rub in turpentine liniment, and bandage.

Cuts and Abrasions.

Dress with wool and sticking plaster, or apply simple ointment, or collodion, and then dress with the two former. A bandage over all may be necessary.

Cracks of the Skin.

Apply some simple ointment or collodion.

Ulcers.

Apply wool or lint soaked in carbolic oil; over this put carbolic plaster, sticking plaster, and bandage. In slight cases simple ointment, spread on lint, can be substituted for carbolic oil.

Contused Wounds or Bruises.

Apply wet lint and a bandage.

Bleeding from Wounds, Gunshot or otherwise.

If blood pour out in a *continuous* stream from any part of a limb, put a compress of lint *on* and just *below* the wound, and bandage from the extremity of the limb to above the seat of injury. If blood pour out in *jets* (a most dangerous thing), apply a tourniquet at once *above* the wound, *i.e.*, between it and the trunk of the body, placing the pad in the course of the wounded artery, and screw up the instrument till bleeding cease, then plug the wound and bandage. If no hæmorrhage recurs on slackening the tourniquet, take it off, but if it does, screw up and plug and bandage again; continue this till bleeding be over. In very obstinate cases it may be necessary to apply frozen snow, at any temperature, to the bleeding part. Never keep the tourniquet screwed up for more than an hour. At any risk it must be slackened, but while it is slackened keep the artery above the wound firmly pressed with the fore, middle, and ring fingers of both hands in line, or press with both thumbs, or with the handle of a sailor's knife covered with lint; eventually a clot may form, and bleeding cease. Always keep the limb somewhat raised.

Plugging is done as follows:—Fold a small piece of lint and place it on the wound, on this put a larger folded piece, and go on adding such till a good sized compress be made. In wounds of trunk never apply a tourniquet, but plug, bandage, or apply cold. In gunshot wounds clean out with sponge and water all light extraneous substances, then endeavour to extract shot or cloth, and dress with carbolic oil, carbolic plaster, and bandage.

Fracture of Bones.

General Directions.—Fractures will generally be detected, 1st, by deformity, the injured limb being bent, shortened, or twisted; 2ndly, by unusual mobility, known by fixing the upper part of the bone with one hand, while ascertaining if the lower one moves independently of it; 3rdly, by a crepitus or grating being heard or felt if the ends be rubbed *gently* together, after being brought into their natural position. In addition, there are, more or less swelling, pain, and helplessness of the injured part; one or more of the foregoing symptoms may be absent, in which case the officer must act to the best of his judgment.

N.B. If after setting and dressing a fracture swelling comes on, or the fingers or toes are blue coloured or benumbed, loosen the bandages, and, if necessary, take off all dressing, and stupe with warm water till the bad symptoms subside, when set up as before. In all fractures of the long bones of the limbs, it is best to rip up the clothes instead of pulling them off; they can be tied with tape over the dressing afterwards.

Fracture of the Skull.—If there is a wound in the scalp, with fracture of the bone, remove any loose pieces of the latter, and dress with wet lint, oiled silk, and bandage. Renew the dressing from time to time.

Collar Bone.—On examination with the hand, the bone will generally be found out of its true line in comparison with the opposite one, the shoulder looks smaller, and the arm cannot be raised. Place a thick pad of tow in the armpit, with a handkerchief or bandage, and bend arm to the side, and put forearm in a sling.

Arm.—For symptoms, read general directions for detecting fracture. Apply carbolized tow neatly round the arm, put on expanding splint, cut to suitable length, draw the bones into as natural a position as possible, by fixing the upper part with one hand, and with the other drawing down the lower, then bandage over splint, and place forearm in a sling.

Fractures of Forearm.—See general directions. Apply tow, put on expanding splint from bend of elbow to roots of fingers, and bandage, taking care to keep the thumb *uppermost*. Place forearm in a sling.

Rib.—There is generally felt a lancinating pain, particularly on taking a deep breath, when also a crackling may be experienced by patient, and heard by another person. Bind flannel bandage round chest, but not so tightly as to impede respiration, and support it with straps over the shoulder.

Thigh Bone.—See general directions. The limb is generally shortened, and the foot falls, as it were, outwards. Place tow neatly round thigh, put on expanding splint, cut to suitable length, pull in the limb till it is as nearly the length of its fellow as possible, and bandage. Then roll a piece of wood (or a musket, if the temperature of the air be above 32° Fah.) in a blanket, and bind it to haunch bones, thigh, and leg. Lastly, strap one leg to another.

Knee Cap.—A hollow will generally be felt across the bone. For a day or two lay leg on a plane, extending upwards to the foot. Foment if inflammation ensue, when it subsides apply tow round joint, cut expanding splint in two lengthwise—one piece inside the other—place this behind knee and bandage.

Bones of Leg.—See general directions. Apply tow round limb, put on expanding splint, draw bones into as natural a position as possible and bandage, taking care to keep the great toe in a line with the *inner* edge of the knee-cap. If ankles be included in the splint, cut holes in it to receive them.

In all fractures of the lower extremities, the man will require to be carried on the sledge, and will probably not be fit for duty for 8 weeks or more.

Compound Fractures.

Here there is wound of flesh as well of fracture of bone. Cut a hole in the splint corresponding to the wound, and dress with lint soaked in carbolic oil, carbolic plaster, and bandage.

Dislocations.

General Directions.—Dislocations will generally be detected, 1st, by deformity, or alteration of the form of the joint, an unnatural protuberance being seen and felt at one part, and a depression at another, with lengthening or shortening of the limb; 2nd, by loss of motion, or a deviation from the proper motion of the joint; in addition there may exist great pain and swelling; it will be well always to compare the injured limb with its fellow, in order to detect the difference between them.

Shoulder Joint.—In the most common form of dislocation the shoulder appears flattened, the limb looks fallen downwards and lengthened, there is a hollow where the

head of the bone ought to be, and the latter may be felt in the armpit, the arm sticks out from the side. Place the man on his back, then let operator sit on the floor, put one foot (without the boot) in the armpit, and press it upwards, while with both hands he draws the arm towards himself, till the head of the bone slip into its socket. Put forearm afterwards in a sling. A good purchase may be got on the arm by tying a towel or silk handkerchief round it with a clove hitch and pulling on the ends.

Elbow Joint.—There will here generally be great deformity and immobility. The forearm will be usually found bent at an angle to the arm. Let an assistant fix the arm, while operator draws forearm steadily and firmly forwards, and then binds it. Put forearm in a sling, which should be worn night and day.

Wrist.—The hand is either drawn backwards or forwards, or is twisted. Let an assistant fix the arm while operator pulls the hand in a straight line forward till natural position be gained. Then cut expanding splint in two, pad each piece, and apply one to back and another to front of forearm and hand. Put forearm in a sling.

Thumb or Fingers.—There is deformity, and perhaps swelling. These dislocations are frequently very difficult to reduce. Put a piece of sticking plaster or lint round dislocated bone, over this tie a piece of tape with a clove hitch, then draw forward on tape with one hand, while fixing the hand with the other.

Hip Joints.—Dislocations of these joints are very rare. They are so hard to deal with, that beyond an endeavour at once to pull the bone into its place in such manner as the officer, in his judgment, may dictate, while an assistant fixes the part above, there is little to be done, save to lay the patient in an easy position till medical aid can be had.

Knee-Cap.—The bone can be felt either inside or outside its true position. Press it into its place with the fingers, while the leg is kept straight.

Ankle Joint.—The sole of the foot is turned inwards or outwards, or the foot will be shortened and the heel lengthened, with the toes pointing downwards. Let an assistant fix the leg, while operator, taking the instep in one hand, and the heel in the other, makes extension till the shape be restored, when the great toe will be in a line with the inner edge of the knee-cap. Then cut expanding splint in two, pad both pieces, cutting holes for the ankles. Put one piece on the inside, and another on the outside of the leg and ankle, and bandage. Frequently there is fracture of the small bone of the leg with dislocation of the ankle, so always put on the splints. Put man on sledge. It will be several weeks before it can be used.

If there be wound of the flesh, treat it as for compound fracture. In dislocations not here described, the officer will be led by the symptoms given in the general directions, and will endeavour to reduce them by fixing and pulling the limb in the most probable direction for restoring it to its natural shape.

Concluding Remarks.

If convenient, let the men use the tent as a W.C. just before it is struck in the morning. Do not let them put snow under 32° Fah. in their mouths. Though in some cases this is rather pleasant at first, the mouth soon feels as if in flames, and the snow is felt like red-hot coals. Do not let them eat the liver of the bear, as such at times causes intense griping. The bear's head has also proved deleterious. It would be advisable to cause all persons sledging to wear flannel belts, 6 inches broad, round the waist, or at least to have them ready for use in case of colic, cramp in the stomach, diarrhoea, &c. Frost-bites will be greatly if not altogether prevented occurring in the legs and feet, if canvas or carpet boots, or mocassins, with a foot-cloth or two of blanket stuff or duffle, and good woollen stockings be worn. The feet should have *plenty of freedom*. Frost-bites frequently occur when leather boots are worn. If the medicines and ointments be frozen, thaw them under the armpit, or before the fire. Always shake the medicines (particularly chlorodyne), before using them. Officers should make themselves well acquainted with scurvy grass and sorrel, in order to make use of them as anti-scorbutics if met with.

THOMAS COLAN, M.D.,
Fleet-Surgeon.

APPENDIX No. 20.

CARBONIC ACID ESTIMATIONS BETWEEN DECKS, H.M.S. "ALERT."

THE apparatus for the volumetric estimation of carbonic acid, was placed in my hands by Fleet-Surgeon Colan, on the 16th October, 1875, with a request that I should make an estimation of the carbonic acid in the air of the "Lower Deck" before the housing in for winter was complete, and at intervals afterwards. The following is an abstract of my results :—

Date	Position and Circumstances of Air Examined	Percentage of Carbonic Acid
23 Oct. '75 before housing	Air taken at midnight from level with the men's heads as they slept, and at a point removed from direct draughts	·220
8 Nov. after housing	Air taken under the same circumstances, and at same time as before	·405
8 Dec.	Air taken as before	·308
16 Jan. '76.	Air taken as before	·2882
29 Feb.	Air taken as before	·436
16 Jan.	Air of Stokehold (temperature — 2°).. .. .	·266
18 Jan.	Air of Ward Room at 11 p.m., 5 feet from floor. Room feeling close. Lamps and candles, of course, constantly burning ..	·482

The value of the results obtained from examination of the external air cannot be correctly estimated without a long description of the three various arrangements made to admit of the examination of a large volume of air at temperatures between —26° and —63° Fah. The average of my observations is ·0552.

EDWARD L. MOSS.

NOTE.—The results of three estimations of the carbonic acid in the outside air at a short distance from the ship, were :—

10th December, 1875	..	0·0641 per cent.
18th January, 1876	..	0·0483 "
29th February, 1876	..	0·0536 "

Average of Estimations .. $0·166 \div 3 =$
0·0552 per cent.

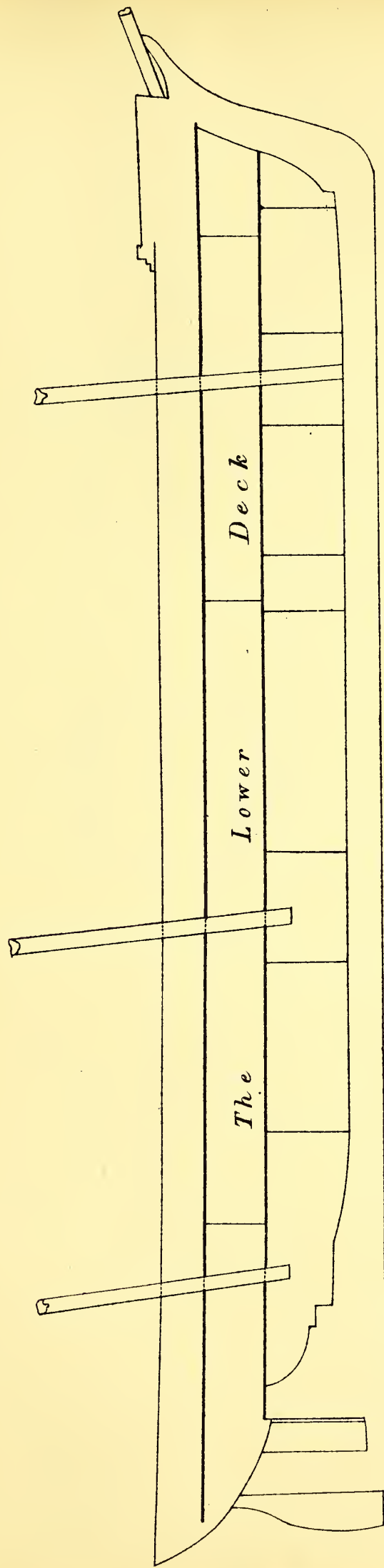
(Abstract from Dr. Moss's Special Report on this subject, dated "H.M.S. 'Alert,' Winter Quarters, North Lat. 82·27.")

The mean of the five estimations given in the Table of the percentage of carbonic acid in the air in the men's sleeping quarters is 0·3314.

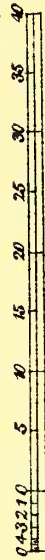
W. Robinson

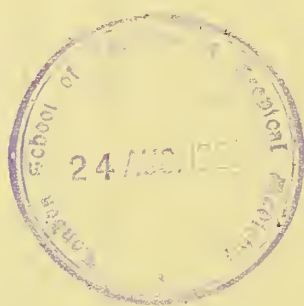
Chief Constructor. 31st Jan^y 1877.
Portsmouth, Yard

**ALERT.
OUTLINE PROFILE.**



Scale $\frac{1}{16}$ " = 1 Foot.

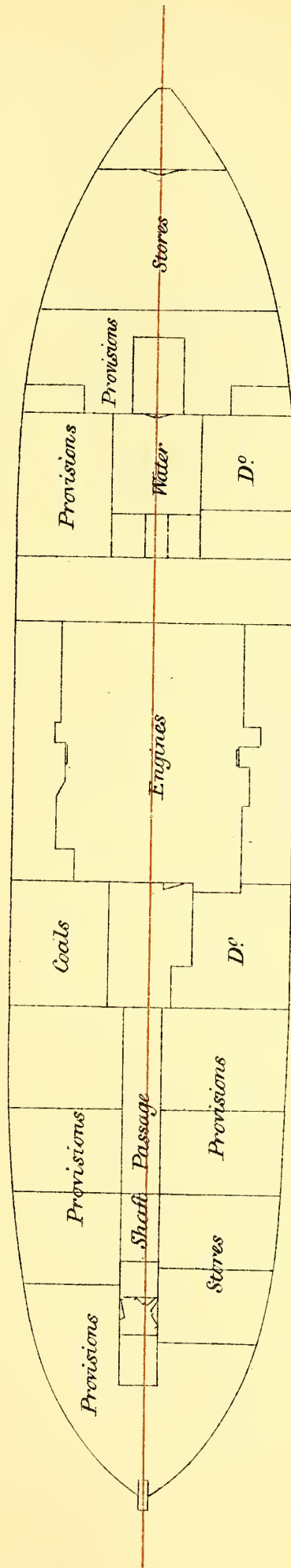




M. J. Rodman

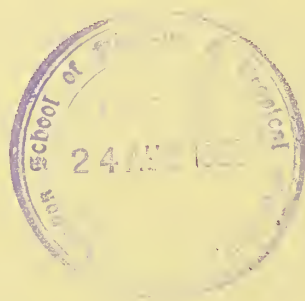
Chief Constructor: 31st Jan^y 1877
Portsmouth Yard.

A L E R T .
OUTLINE PLAN OF
H O L D .



Scale $\frac{1}{16}$ in. = 1 Foot

0	5	10	15	20	25	30	35	40
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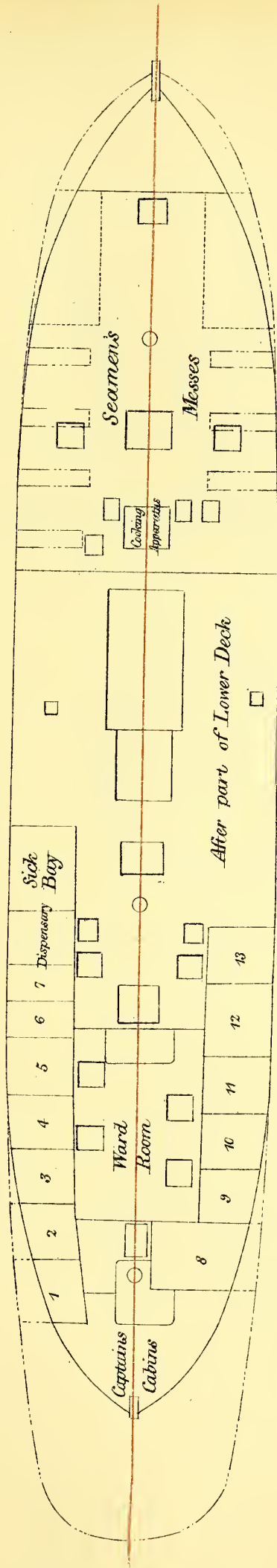
W. Prodman

Chief Constructor, 31st Jan^r 1877.
Portsmouth Yard

ALERT.
OUTLINE PLAN OF
LOWER DECK

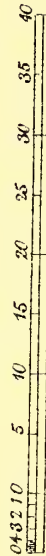
Complement
Captain 1
Officers 42
Men 50

In addition to these
1 Lieutenant } Wintered on
7 Men } Board "Alert"
of the "Discovery"

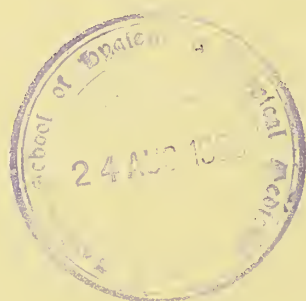


Cubic Space
Captain's Cabin 968
Officers' Mess Room and Cabins 5,168
For Seamen, Fore Lower Deck 6,165
Do After Lower Deck 6,535
Sick Bay 697

Scale $\frac{1}{16}$ " = 1 Foot.



Officers' Cabins Nos 4 to 13.



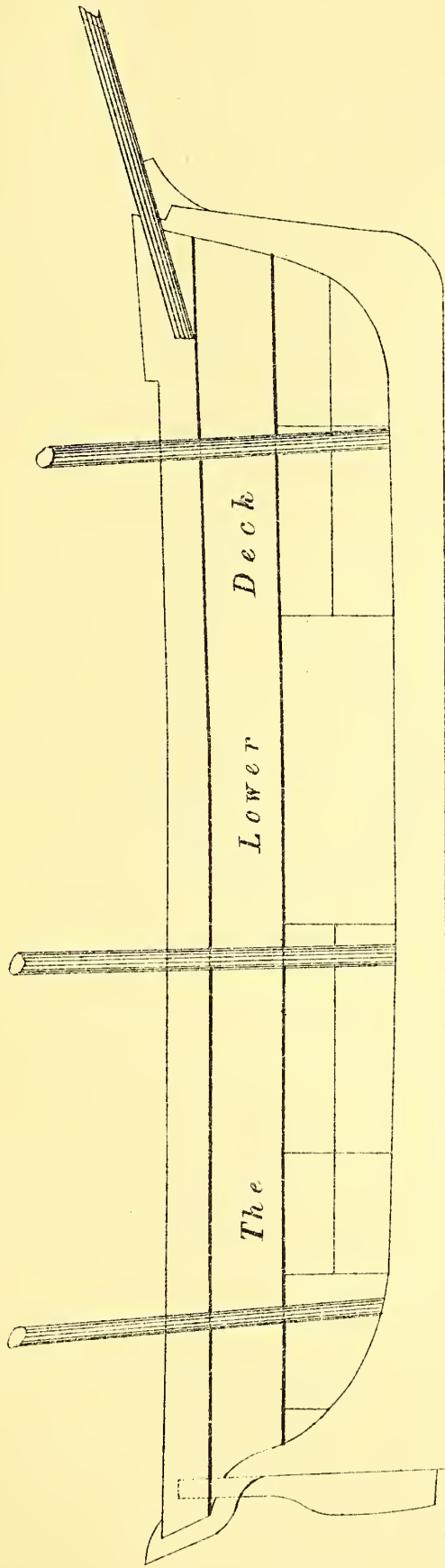
W. M. Moberg

Chief Constructor 31st Jan. 1877
Portsmouth Yard

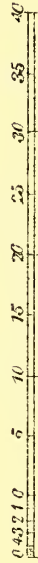
RESOLUTE. OUTLINE PROFILE.

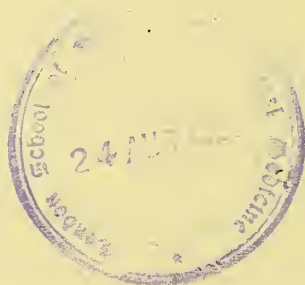
Complement 1852 to 1854 exclusive of tender.

1 Captain.
12 Officers.
49 Men.



Scale $\frac{1}{8}$ in. = 1 Foot.





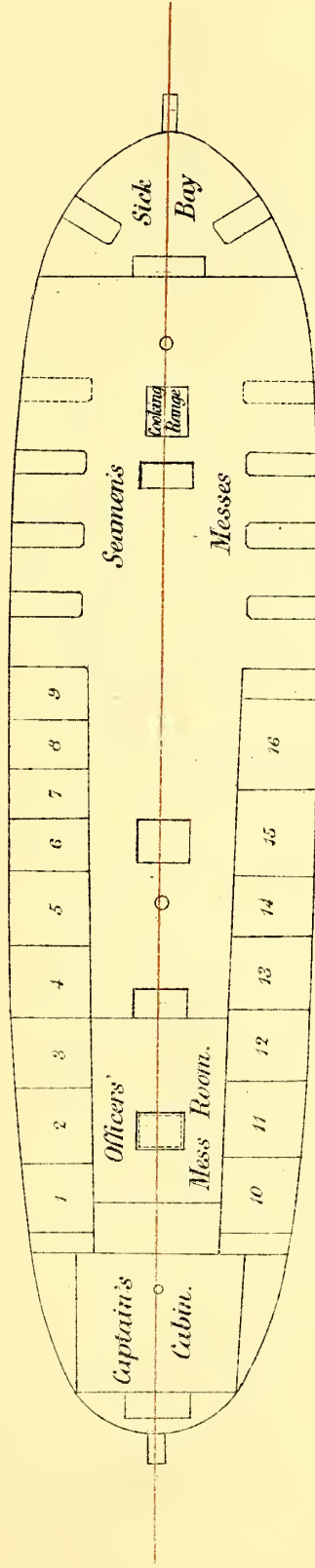
M. M. M. M.

Chief Constructor: 31 Jan. 1877.
 Portsmouth Yard.

RESOLUTE. **OUTLINE PLAN OF** **LOWER DECK.**

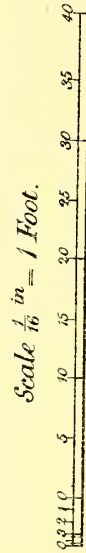
Complement 1852 to 1854 exclusive of tenders.

Captain.....1
 Officers.....12
 Men.....49



Officers' Cabins Nos 1 to 16.

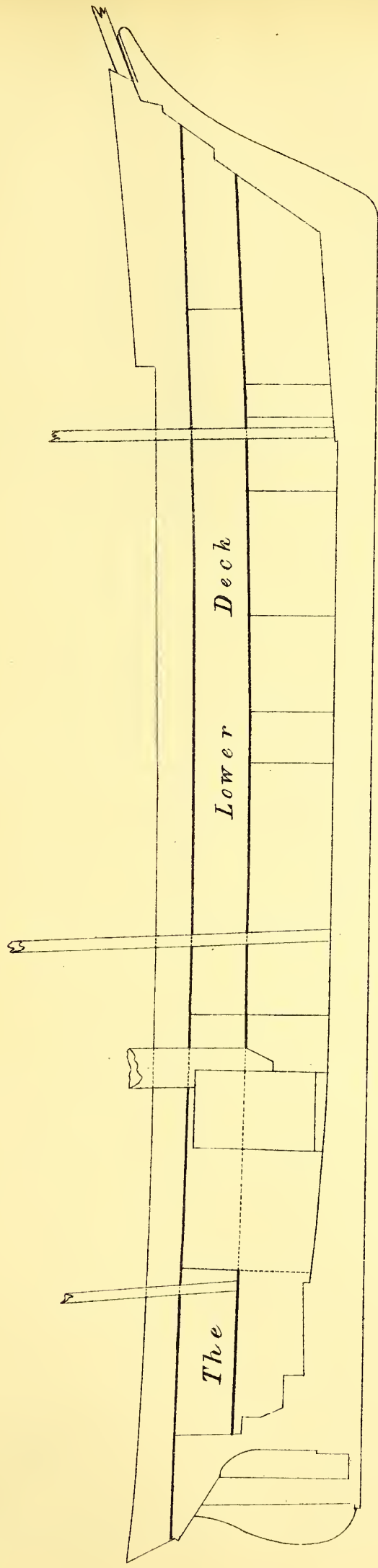
Cubic Space. Ft
 Captain's Cabin.....924
 Officers' Messroom and Cabins.....3,129
 For Seamen.....6,240
 Sick Bay.....990



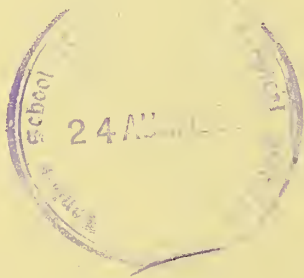


W. M. Moberly
 Chief Constructor 31st Jan^y 1877
 Portsmouth Yard.

DISCOVERY. OUTLINE PROFILE.

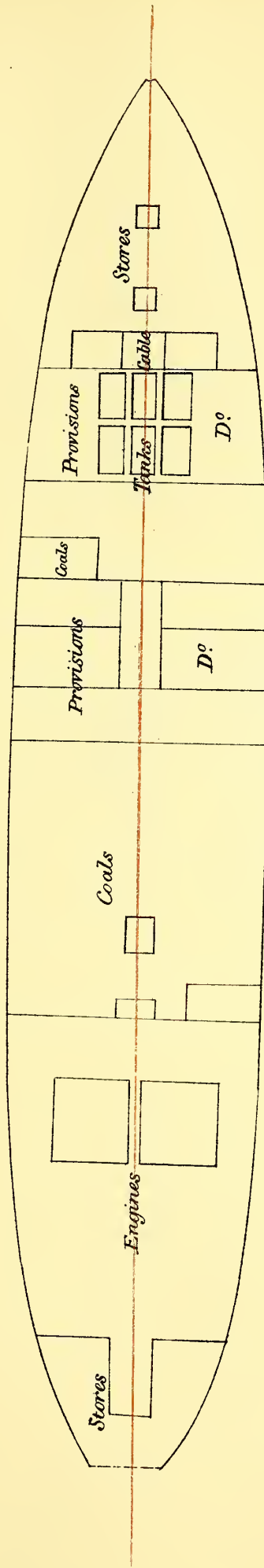


Scale $\frac{1}{8}$ in = 1 Foot.
 0 4 3 2 1 0 5 10 15 20 25 30 35 40

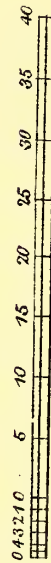


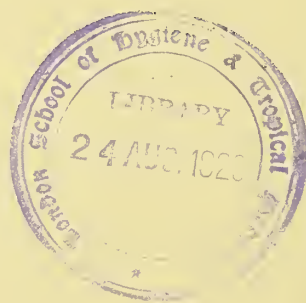
Chief Constructor 31st Jan^y 1877.
Portsmouth Yard

DISCOVERY.
OUTLINE PLAN OF
HOLD.



Scale $\frac{1}{16}$ in. = 1 Foot.





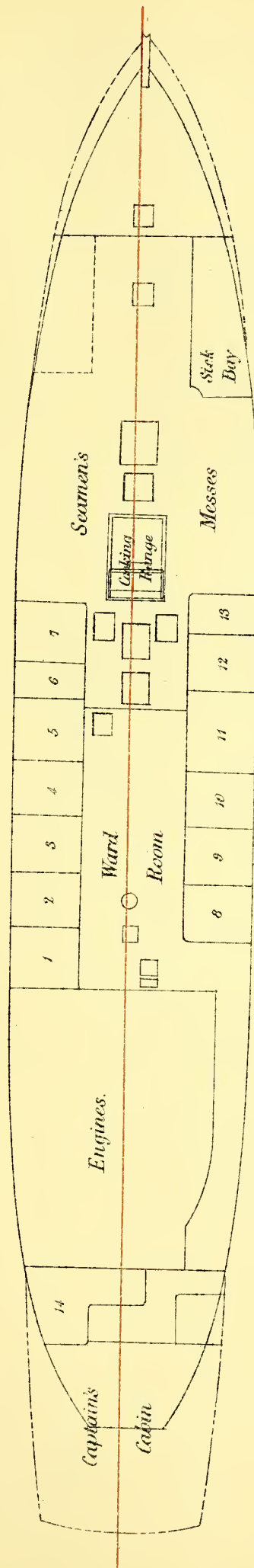
C. M. Robinson

Chief Constructor, 31 Jan. 1871.
Portsmouth Yard.

DISCOVERY. OUTLINE PLAN OF LOWER DECK.

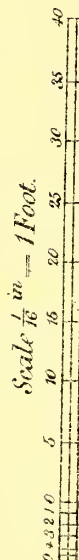
Complement.
Captain 1
Officers 12
Men 47

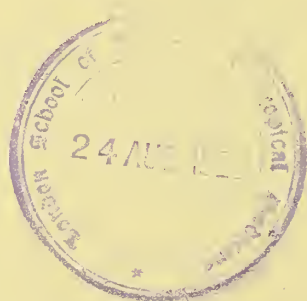
Note. Out of this number
1 Lieutenant } Wintered on board
7 Men } the Alert.



Officers' Cabins Nos 1 to 14.

Cubic Space. Ft
Captain's Cabin 783
Officers' Messroom and Cabins 4,923
For Seamen 4,999
Sick Bay 514





APPENDIX No. 21.

H.M.S. "DISCOVERY."—CARBONIC ACID ESTIMATIONS.

Date.	Place.	Temperature.	Barometer.	Per Cent.	Remarks.
1875.					
5 June ..	Sick Berth	18	..	·276	
16 " ..	Lower Deck	18	29·64	·33	Where crew sleep.
16 " ..	Upper Deck .. ..	..	30·22	·18	In the open air.
24 " ..	" "	5·5	29·73	·095	
29 " ..	Staff Surgeon's Cabin ..	9	29·50	·219	7·30 A.M.; occupied since mid- night.
12 July ..	Sick Berth	16	29·75	·417	3 persons in it for 10 minutes.
14 " ..	" "	17	29·90	·321	1 person in it for 30 minutes.
1 Sept. ..	Upper Deck	0	29·625	·164	Snowing slightly.
2 " ..	" "	9	29·42	·118	
5 " ..	" "	-11	29·97	·11	11 A.M.
5 " ..	" "	-11	29·97	·23	
21 Oct. ..	Lower Deck	6·6	29·93	·330	Ship frozen in; men in bed.
22 " ..	Ward Room	12·7	30·04	·461	10 P.M.; seven persons present.
27 " ..	Upper Deck	-30	30·24	·084	10 A.M.
27 " ..	Lower Deck	+4	30·24	·536	10 P.M.
29 " ..	" "	+20			
30 " ..	Captain's Cabin	+7	30·17	·470	11 A.M.
3 Nov. ..	Upper Deck	-22	30·51	·085	5 P.M.
3 " ..	Lower Deck	+10	29·925	·384	10·30 P.M.
10 " ..	Upper Deck	-28	30·58	·103	5 P.M.; clear.
10 " ..	Lower Deck	+11	30·63	·352	10·30 P.M.
10 " ..	" "	+11	30·63	·275	Dry Jar used.
17 " ..	Upper Deck	-30·5	29·96	·084	5 P.M.
17 " ..	Lower Deck	+10	30·10	·431	5 P.M.; clear.
19 " ..	" "	19·4	29·85	4·2	Own breathed air.
24 " ..	Upper Deck	-35·5	30·26	·076	5 P.M.
24 " ..	Lower Deck	+9	30·314	·536	10·30 P.M.
2 Dec. ..	Upper Deck	-21	30·103	·106	5 P.M.; clear and still.
2 " ..	Lower Deck	+10·5	29·824	·557	11·15 P.M.
8 " ..	Upper Deck	-20·5	30·34	·106	5 P.M.; clear.
8 " ..	Lower Deck	+11·5	30·363	·4508	11 P.M.
16 " ..	Upper Deck	-30	29·234	·107	9·30 P.M.; clear.
16 " ..	Lower Deck	+15	29·234	·5101	11·30 P.M.
20 " ..	Upper Deck	-42·4	29·300	·120	5·20 P.M.
22 " ..	" "	-44·4	29·321	·123	5·20 P.M.
23 " ..	Lower Deck	+9	29·500	·499	10·45 P.M.
29 " ..	Upper Deck	-32·7	29·174	·1171	5 P.M.; hazy.
29 " ..	Lower Deck	+9·5	29·211	·480	10·40 P.M.
1876.					
5 Jan. ..	Upper Deck	-31·6	29·534	·116	5·25 P.M.; clear.
5 " ..	Lower Deck	+11	29·55	·489	11 P.M.
12 " ..	Upper Deck	-32·7	29·64	·1466	4·50 P.M.; hazy.
12 " ..	Lower Deck	+9·5	29·534	·4024	Midnight.
19 " ..	Upper Deck	-44	29·823	·1406	4·50 P.M.; hazy.
20 " ..	" "	-43	29·604	·1218	5 P.M.; still.
21 " ..	Lower Deck	+11·5	29·633	·3424	11 P.M.
26 " ..	Upper Deck	-45·5	29·81	·1200	5 P.M.
26 " ..	Lower Deck	+9·5	29·632	·4620	11 P.M.
2 Feb. ..	" "	+12	29·940	·4004	11·30 P.M.
9 " ..	On "Floe"	-42	30·034	·1976	6·25 P.M.
9 " ..	Lower Deck	+10·5	30·043	·3565	11 P.M.
16 " ..	Upper Deck	-41·6	30·532	·1186	6 P.M.
16 " ..	Lower Deck	+9·5	30·500	·2857	10·40 P.M.
23 " ..	Upper Deck	-41·1	30·440	·1289	5·10 P.M.
23 " ..	Lower Deck	+7·7	30·354	·4007	11·5 P.M.

EXPLANATORY NOTES.

Mean of twenty examinations of the air of the Lower Deck under similar circumstances '43775.

Mean of twenty-four examinations of the external air on Deck under similar circumstances '12056.

The "Lower Deck" is where the men live and sleep. It was clear for a few hours during the day-time, but fully occupied after 6 P.M. Men were all in their hammocks by 9 P.M.

The percentages are corrected for Temperature and Barometric pressure.

The air examined was taken about two feet from the floor, between Decks, the men being in their hammocks.

Unless otherwise specified all examinations were made with the "Wet Jar."

In examining the Upper Deck air care was taken that it was not mixed with that coming up from below. It was collected under the awning, but near the ship's side, the curtain being triced up. The air shafts opened above the awning.

BELGRAVE NINNIS, *Staff Surgeon,*
H.M.S. "Discovery."

APPENDIX No. 23.

ANALYSES OF PEMMICAN AND PRESERVED POTATO. BY SURGEON-MAJOR DR. DE CHAUMONT, M.D.

I. Ordinary Pemmican.

Water	7.17	per cent.
Albuminates	35.45	"
Fat	55.20	"
Salts (mineral matter)	1.82	"
Total	99.64	"
Loss	0.36	"
Total	100.00	"

These are the mean results of several determinations.

Nitrogen (mean)	5.536	grains per cent.
Carbon	61.920	" "
Nitrogen and carbon = 1 : 11.18		

In a ration of 1 lb. :—

Nitrogen	387.5	grains.
Carbon	4334.4	"
Potential energy of 1 lb. 3,470 foot-tons.		

This sample contained no added salt ; when boiled in water it yielded under 0.005 per cent. of sodium chloride, or about one-third of a grain in the pound. The total amount of sodium chloride found in the ash on incineration (November, 1876) amounted to 0.2672 per cent., or less than 18 $\frac{3}{4}$ grains in one pound.

II. Sweetened Pemmican.

This has a slightly sweetish taste, but is otherwise like the ordinary pemmican.

Water	9.40	per cent.
Albuminates	31.84	"
Fat	51.58	"
Sugar (cane)	5.48	"
Salts (mineral matter)	1.27	"
Total	99.57	"
Loss	0.43	"
Total	100.00	"

These are also (with the exception of the ash) the means of several determinations. The ash seems a little small, but it was only determined once. The sugar was determined both by Fehling's test and by polarization, the mean being taken. In both samples pepper had been added, which is doubtless partly included in the "loss."

Nitrogen	5.031	per cent.
Carbon	60.305	"
Nitrogen to carbon = 1 : 12		

In a ration of 1 lb. :—

Nitrogen	352	grains.
Carbon	4221	"
Potential energy 3,306 foot-tons.		

III. Mean of the two kinds of Pemmican.

As there is no definite statement as to the quantities of each kind of pemmican issued, I have assumed the mean of the two as the amount to be adopted in the calculations, as follows :—

Water	8.285	per cent.
Albuminates	33.646	"
Fat	53.391	"
Carbo-hydrate (sugar)	2.740	"
Salts (mineral matter)	1.544	"
Total	99.606	"
Loss	0.394	"
Total	100.000	"
Nitrogen	5.283	grains per cent.
Carbon	61.112	" "
Nitrogen to carbon = 1 : 11.6		

In a ration of 1 lb. :—

Nitrogen	370	grains.
Carbon	4278	"
Potential energy of 1 lb. 3,388 foot-tons.		

Preserved Potato.

A sample of the potato used on the sledge expeditions yielded the following results:—

Water		9.870 per cent.
Free acidity (calculated as citric acid)	0.436	Total vegetable } acid as } citric acid }
Combined acid calculated as citric acid from the alkalinity of the ash	0.649	
Ash (mineral matter including the potash combined with citric acid) ..		2.332
Starch and other acids, not ash or citric acid		86.713
Total		100.000

* The ration of 2 ounces of preserved potato, therefore, would be equal to $9\frac{1}{2}$ grains of citric acid, or about a quarter of an ounce of lime juice, provided the *whole* of it was utilized.

Fresh Potato.

Fresh raw potato yielded the following:—

Free acidity (as citric acid) ...	0.1075	Total acid } as citric }	0.4503 per cent.
Combined acidity (as citric acid) from the alkalinity of the ash	0.3428		
Ash			1.1476

I did not directly determine the water and total solids, but from known analyses the average amounts are:—

Water	74 per cent.
Solids	26

Total 100

From this we find the following proportions between the dried and the fresh potato:—

Calculated from total solids	1 part of dried is equal to 3.5 parts of raw fresh potato.
" " ash	1 " " 2.0 " "
" " free acid	1 " " 4.1 " "
" " combined do.	1 " " 1.9 " "
" " total do.	1 " " 2.4 " "
Mean	1 " " 2.78 " "

Accordingly a ration of two ounces of dried potato would not be equal to more than half-a-pound of fresh potatoes at the highest computation, or it may be stated as follows:—

Calculated from total solids	2 oz. of dried are equal to 7 oz. of raw fresh potato.
" " ash	2 " " 4 " "
" " free acid	2 " " $8\frac{1}{5}$ " "
" " combined do.	2 " " $3\frac{2}{5}$ " "
" " total do.	2 " " $3\frac{3}{5}$ " "
Mean	2 " " $5\frac{2}{5}$ " "

The ration may therefore be considered as of less value than half-a-pound of ordinary potato.

On soaking the dried potato in cold water (as required for cooking it) it was found that the water poured off yielded acid to the amount of 0.448 per cent. on the weight of potato, or *all* the free acid disappeared in the process. It is probable, also, that the vegetable salts were at least partly lost, but this was not directly determined. Thus quite one-half of the available vegetable acid might be lost, unless the water used for soaking was employed in cooking and consumed with the food.

APPENDIX No. 24.

CORRECTED ESTIMATE BY SURGEON MAJOR DR. DE CHAUMONT, M.D.,
OF THE AMOUNT OF WORK DONE BY THE NORTHERN SLEDGE
PARTY COMPARED WITH THE POTENTIAL ENERGY OF THE DIET
(WITH REFERENCE TO QUESTIONS 5,006-7.)

In my first calculation (which I had a very short time to make) I assumed that the weight at starting might be taken as the mean of the whole journey. On looking further into the matter I found that this gave an under-estimate of the work, and I have therefore re-calculated the figures, allowing for the progressive diminution of weights as provisions were eaten, &c. At certain points in the journal there are *land marks* where the weights are actually stated, so by that means an approximate estimate can be made. The following results come out:—

† N.B.—The co-efficient of resistance for the sledges is taken at $\frac{1}{6}$, and for the men marching at $\frac{1}{10}$.

I. During the first seven days, per day—

Mean sledge weight dragged per man..	..	227 lbs.
„ distance made good (statute miles)	..	5.3 miles.
„ „ marched (statute miles)	..	12.3 „
„ work done per man .. ..	..	763 foot-tons.
Maximum work done per man (4th April)	..	859 „

II. From Cape Joseph Henry to end of journey, per day—

Mean sledge weight dragged per man ..	..	423 lbs.
„ distance made good .. ..	..	2.14 miles.
„ „ marched (statute miles)	..	9.1 miles.
„ work done per man .. ..	..	571 foot-tons.
Maximum work done per man (17th May)	..	744 „

III. Total for 67 working days, per day—

Mean weight dragged per man .. ..	..	375 lbs.
„ distance made good .. ..	..	2.48 miles.
„ „ marched .. ..	..	9.27 „
„ work done .. ..	..	574 foot-tons.

Mean for 72 days (including five days' rest).

Mean work done.. .. 534 foot-tons.

The above is the estimate for each *working* man.

As all the rations were not consumed, and in particular only a portion of the pemmican, the productive value of the food would not exceed 450 foot-tons, and would probably fall short of that number. The men were therefore worked much beyond the *theoretical* value of their rations. The above too does not include the labour of road making.

REMARKS ON ABOVE BY CAPTAIN MARKHAM.

Sir,

In compliance with the request of Sir James Hope, conveyed to me in your letter, I beg to submit the following remarks on the calculations, and evidence, of Dr. De Chaumont.

His theory regarding the amount of work performed by the Northern sledge party under my command, as compared with the amount of food partaken, is very interesting, but, in my opinion, it is only so in a theoretical point of view, and cannot be entertained in practice, in such duties as we were engaged on. A leader cannot judge of the capabilities of those under his command by the amount of provisions they individually consume.

So far as my own experience goes, I can only state that I invariably halted my party immediately symptoms of fatigue were exhibited by them.

Had I done so before signs of fatigue were detected, or before what I considered a good day's work had been accomplished, I consider I should have failed in the zealous carrying out of the enterprize entrusted to my charge.

On carefully going over Dr. De Chaumont's calculations, it seems to me that they have been formed on wrong data.

The weights, adopted by him as those dragged by the men under my command, are excessive. It appears to me that he has omitted the officers entirely in his calculations.

The extreme weight dragged by each man, *at one time*, never exceeded $236\frac{1}{2}$ lbs., and this only on first leaving the ship.

Dr. De Chaumont states, that the mean sledge weight dragged per man, from the time of leaving Cape Joseph Henry to the end of our journey, was 423 lbs., a condition of things that would be absolutely impossible over the description of road along which we travelled, or indeed any other except on the very smoothest and most level ice.

I presume, in his calculations, he has added the weights of the sick men who were carried on the sledges, and has deducted their strength from our motive power; but this was an abnormal state of affairs produced by the unexpected outbreak of scurvy, and which can hardly be taken into consideration; should it be so, however, the loss of

weight caused by the abandonment of the two boats, besides various other articles, must of necessity be considered. If he has failed to do this, his conclusions would be erroneous.

His estimate of the average weight of each man is, I think, excessive. I was the only one of the party weighed before starting on the spring campaign, fully equipped for travelling. My weight then was 187 lbs., but it must be remembered that I was carrying many things which the men were not, namely—a double barrelled gun, twelve rounds of ammunition, a telescope, compass, and other instruments, besides an alpenstock, *all* being included in the 187 lbs.

A fair *average* weight for each man would, in my estimation, be about 180 lbs.

This difference would alone very materially alter the calculations of Dr. De Chaumont, rendering his results of doubtful value even in a theoretical point of view.

The co-efficient of resistance for the sledges is in all probability nearly correct, but I consider the co-efficient of resistance for the *men* marching to be infinitely greater than that of the sledges.

These are, I think, the only points on which it is necessary for me to make any remarks.

I have the honor to be,

Sir,

Your obedient Servant,

A. H. MARKHAM,

Captain, R.N.

To H. J. Vansittart Neale, Esq.,
Secretary to Committee.

CORRECTED ESTIMATE BY SURGEON MAJOR DR. DE CHAUMONT, M.D.,
OF THE AMOUNT OF WORK DONE BY THE WESTERN SLEDGE
PARTY COMPARED WITH THE POTENTIAL ENERGY OF THE DIET
(WITH REFERENCE TO QUESTION 5,008).

This journey was less arduous than Markham's, and the days may be divided into "Bad," "Good," and "Indifferent." For these I have allowed the following co-efficients of traction:—

"Bad" days' travelling	$\frac{1}{6}$	(same as in Markham's).
"Good" days' travelling	$\frac{1}{30}$	(a little more than macadamized roads).
"Indifferent" days' travelling	$\frac{1}{10}$	(about the same as soft gravel).
Mean	$\frac{1}{10.7}$	

The number of days were—

"Bad"	36	
"Good"	27	
"Indifferent"	19	
Total	82	working days
Rest days	2	no dragging.
Total of journey	84	

My first calculation assumed the starting weight of 241 lbs. as the mean; this turned out to be an over estimate.

I. "Bad" days—

Mean weight dragged	186 lbs.
„ distance made good	5.1 statute miles.
„ „ marched	8.8 „
„ work done	581 foot-tons.

II. "Good" days—

Mean weight dragged	..	..	..	161 lbs.
„ distance made good..	..	..	..	8.5 statute miles.
„ „ marched	..	..	..	8.9 „ „
„ work done	..	..	..	318 foot-tons.

III. "Indifferent" days—

Mean weight dragged	..	..	..	174 lbs.
„ distance made good..	..	..	..	5.2 statute miles.
„ „ marched	..	..	..	6.7 „ „
„ work done	..	..	..	372 foot-tons.

IV. Total journey—

Mean weight dragged	..	..	..	175 lbs.
„ distance made good..	..	..	..	6.2 statute miles.
„ „ marched	..	..	..	8.6 „ „
„ work done	..	..	..	443 foot-tons.

The above for 82 working days.

For 84 days (including rests) work done 432 foot tons.

This was probably close up to the value of the rations consumed, if not beyond.

REMARKS ON ABOVE BY COMMANDER ALDRICH.

With reference to the mean weight dragged—The weight of a daily ration is about 3 lbs., and supposing each man eats his allowance, it follows he has that much weight less to drag day by day. On this supposition (viz., that the allowance was eaten), my men had to advance 230 lbs. per man (only seven pulling however) from April 3rd to April 30th; during this time a distance of 107 statute miles was made good, and 275 statute miles were travelled. With the exceptions of April 3rd, April 21st, and April 30th, during which we were single manned, and travelled 17 miles, the average weight each man had to drag was $\frac{230}{2} = 115$ lbs., which weight, seeing that the sledge itself had to be dragged both ways when advancing by half loads, that a proportion of the provisions were not consumed, and that the robes, &c., accumulated weight from absorbing moisture, may perhaps be increased to 125 lbs., but this was dragged $\frac{2}{3}$ of the whole distance travelled.

Therefore, for that, which was the only very hard part of my outward journey, we have the following data:—

Distance made good by double manning and half loads = $107 - 17 = 90$ statute miles, therefore 180 miles were travelled dragging a mean weight of 125 lbs.; 17 miles dragging a mean weight of 227 lbs.; and 275 miles was the total distance walked.

On May 1st I got rid of 300 lbs., and on the 8th, 145 lbs. more, by leaving them in dépôts. Therefore from May 1st to the end of my outward journey on the 18th, I consider the mean weight dragged = 151 lbs., the maximum being 187 lbs. on the former date, and the minimum 118 lbs. on the latter date. During this time we made good 154.6 miles, and travelled 156.4 miles, which shows that the travelling had much improved, and indeed for a good part of the way, was nearly everything to be desired.

On the homeward journey I feel quite at a loss to estimate at all. The actual weight on the sledge was considerably reduced, and for some days we had but little more than our constant weights, but the failing strength far more than counterbalanced that, and for a few days after leaving Cape Colan dépôt, I have no doubt those in the belts were dragging close up to 300 lbs., I mean the healthy men, as the actual weight on the sledge was over 1,000 lbs.

For the outward journey I calculate as follows:—

28 days	{	180 miles, dragging 125 lbs., very bad snow.
		17 miles, dragging 227 lbs., fair snow.
		240 miles, walking through very bad snow.
		35 miles, walking through fair snow.
18 days	{	156 miles, dragging 151 lbs., travelling good.
		156 miles, walked through good snow.

All this latter travelling was better than the best of the former, and mostly very good.

The various co-efficients to be used I cannot venture to offer an opinion on, merely observing, that on May 1st, at one part of the march, we were dragging 187 lbs. per man, nearly 3 miles an hour if not more, without any difficulty whatever, and on June 8th we had considerable difficulty with a very light load, and farther, that I think it is less distressing to walk 3 miles an hour along a macadamized road, than one through deep snow, covered by a crust which is sufficiently strong, not to bear you, but to prevent your forcing your leg through it horizontally.

I remain,

Sir,

Yours truly,

P. ALDRICH.

*The Secretary
to the Committee.*

APPENDIX No. 25.

DIETARY OF CONVICTS AT HARD LABOUR COMPARED WITH THE
DIETARIES OF THE SAILORS ON BOARD SHIP, AND OF THOSE
BELONGING TO THE SLEDGING PARTIES.

BY DR. GUY

Convicts at Hard Labour.		Seamen on Board.		Sledging Parties.	
Solids.	Per week.	Solids.	Per week.	Solids.	Per week.
	oz.		oz.		oz.
Bread	168	Biscuit	40 } 112	Biscuit	98
Meat	15 } 31	Soft bread	72 }	Pemmican	112 } 140
Ditto, in soup	15 }	Preserved meat, and	98	Bacon	28 }
Cheese	4	corned beef and pork		Preserved and com-	
Potatoes	96	pressed soup, count-	14	pressed vegetables	14
Flour	8	ed as meat		Onion and curry	
Suet	1½	Preserved and com-	30	powder	2
Onions	3	pressed vegetables..		Chocolate	7
Pearl Barley	2	Flour, suet, and cur-	21	Sugar	14
Fresh vegetables, in soup	4	rants	7		
Cocoa	3½	Pickles.. .. .	7		
Oatmeal.. .. .	14	Split peas	4		
Molasses, counted as		Fruit	7		
sugar.. .. .	7	Chocolate	21		
		Sugar			
Total	335	Total	321	Total	275

Convicts at Hard Labour.		Seamen on Board.		Sledging Parties.	
Liquids.	Per week.	Liquids.	Per week.	Liquids.	Per week.
	oz.		oz.		oz.
Milk	14	Tea	7	Tea	7
Molasses, as above	7	Lime juice	7	Lime juice	—
Tea	—	Rum or spirits	3½ gills	Rum or spirits	3½ gills
Lime juice	—	Vinegar and condi-		Vinegar and condi-	
Rum or spirits	—	ments	1	ments	—
Vinegar and condiments	—				

APPENDIX No. 26.

REPORT BY CAPTAIN FEILDEN ON POSSIBILITY OF REARING
ARCTIC PLANTS AS ANTISCORBUTICS.

Langholm Villa, Shooter's Hill, S.E.,

1st February, 1877.

My dear Sir,

In answer to the question asked me by the Committee on Scurvy as to the likelihood of rearing arctic plants as antiscorbutics artificially in high northern latitudes, I beg to enclose the following remarks. Between the latitudes of 82° and 83° N. we found three species of plants growing, the antiscorbutic qualities of which are admitted.

Cochlearia Officinalis, scurvy-grass. A few stunted miserable looking plants were added to our herbarium after diligent search.

Taraxacum, dandelion. A few plants of this species appeared towards the middle of July on spots where the snow had disappeared.

Oxyria Reniformis, mountain sorrel, though stunted, was apparently abundant, and towards the end of July I believe a sufficiency was gathered to enable the Medical Officers to issue it as a diet in the hospital of H.M.S. "Alert." For the two or three weeks that this plant remains in leaf it is more a question of labour to collect it than supply.

I understand that *C. Officinalis* is sometimes cultivated in Europe; being sown in July, it will be fit for use in the following spring.

The objection against attempting to rear these plants artificially in the Arctic, lies in their being perennials. I mentioned the subject to Dr. Hooker, and he has written me the following note, which I enclose, as the opinion of such a high authority is of great value.

I am, &c.

H. W. FEILDEN.

To H. J. Vansittart Neale, Esq.,
Secretary to the
Committee on Arctic Scurvy.

LETTER FROM DR. HOOKER, TRANSMITTED BY CAPTAIN FEILDEN.

Royal Gardens, Kew,

30th January, 1877.

Dear Captain Feilden,

It would never be worth the while to cultivate *Taraxacum*, it being a perennial, and what you want are fast growing annuals. So too with the sorrel, it would not make much progress from seed in a summer, nor would probably the scurvy-grass.

Mustard and cress is by far the best, and I cannot conceive why it should not serve all the purposes of *hygiène* in respect of scurvy. Radishes would be the next best crop. Then turnips for the tops only.

I am, &c.

J. D. HOOKER.

You are most welcome to cite my authority.

APPENDIX No. 27.

PAPER HANDED IN BY DR. RAE ON SIR JOHN RICHARDSON'S
SEARCHING EXPEDITION, 1848-49.

RATIONS used by Officers' Mess, Six Persons in all, including Two Servants, during part
of the Winter 1848-49, at Fort Confidence, Great Bear Lake.

1848.	Rations served out.					Rations.		Difference being Rations saved.	Scale of Rations at Full Allowance.	Fresh Venison.	Half Dried Meat.	Large Fish.
	Fresh Venison.	Half Dried Venison.	Grain.	Reindeer Tongues.	Fish.	As per Full Allowance.	Consumed.			lbs.	lbs., or	each, or
									Man	8	4	3
									Woman	4	2	2
									Child	2	1	1
Remarks, &c.												
October ..	115	86	36	69	173	186	122	64	22 lbs. Flour, 24 lbs. Sugar, and 1 lb. Tea.			
November .	211	27	35	40	96	180	87	93	14 lbs. Flour, 22 lbs. Sugar, and 1 lb. Tea.			
Christmas.												
December .	271	7	24	36	123	186	93	93	64 lbs. Flour, 29 lbs. Sugar, and 1½ lb. Tea.			
1849.												
January ..	220	8	19	20	103	186	75½	110½	*32 lbs. Flour, 28 lbs. Sugar, and 1½ lb. Tea.			
February..	243	..	20	19	114	168	80	88	} Cannot find account of Flour, Sugar, and Tea for these three months. J. R.			
March	270	..	22½	21	114	186	85	101				
April	229	..	23½	16	87	180	70½	109½				
Totals. .	1,559	128	180	221	810	1,272	613	59				
	195	32	72	44	270	613			= Rations of each kind of Food used.			
						659			Rations, less than full allowance.			
* In January and April one, if not two of the Mess were absent for a week or more.												
Apparent daily consumption of Provisions by each Member of the Mess:—												
About 3¾ lbs. Fresh Venison.												
Or 1¾ lb. Half Dried Venison.												
Or 4½ lbs. Fish.												
½ lb. Flour.												
Potatoes, a small quantity.												
2 oz. Sugar.												
⅓ oz. Tea.												

RATIONS served out to Five Englishmen wintering at Fort Confidence, Great Bear Lake
1848-49.

1848.	Rations.					Remarks, &c.
	Fresh Venison.	Half Dried Venison.	Fish.	Reindeer Tongues.	Full Rations.	
	lbs.	lbs.				
October	90	361	192	..	165	} This was for 6 Men. 5 Men. 5 "
November	358	112	176	..	131	
December	609	19	137	7 tongues 13 lbs. fat	133	
1849.						There are 212 days in these seven months, which, for 5 men during six months, and 6 men for one month, would give—
January	566	44	141	8	131	5 " 1,091 full rations.
February	722	16	129	10	139	5 " 1,021 full rations were issued.
March	790	108	100	12	161	5 " (?)
April	648	196	83	20	161	5 " (?) 70 rations not used by Men.
Totals.. ..	3,783	856	958	13 lbs. fat 57	1,021	
						During eight months, 124 lbs. of Flour and Barley Meal were served out, equal to about $\frac{1}{10}$ lb. per Man a day. About half of this was issued at Christmas time.

APPENDIX No. 28.

PAPER HANDED IN BY DR. RAE. COPY OF PORTIONS OF A LETTER
FROM ROBERT CAMPBELL, Esq., LATE CHIEF TRADER IN THE
HUDSON'S BAY COMPANY'S SERVICE, TO JOHN RAE, M.D.

Glenlyon, Perthshire, Scotland,
3rd February, 1877.

My dear Sir,

In reply to your query, "How long have I lived at one time, whilst in the Hudson
" Bay Company's service, without vegetables of any kind, or how long have any officers or
" men, to your knowledge, lived without vegetables?"

I may state that from the date of my appointment to explore and extend the
trade (*with the Indians*) on the West Branch of the Mackenzie River, and in the Rocky
Mountains in 1837, up to my leaving it, 1852, neither I nor those with me during that
period (15 years) had vegetables of any kind. As we were extending the trade post
after post, no cultivation of the soil could be attempted, and of course no kind of vegetable
was available. We had 1 cwt. of flour, or sometimes 2 cwt., sent to us annually (officer's
allowance); of this on rare occasions (Sundays) we had a biscuit-like cake made, but the
flour was generally reserved for the Christmas holiday feasts for all hands about the
establishment.

During two of the above years, by an unfortunate accident, we had neither flour nor
vegetables, and for three years I received no letters.

During this period of some 15 years, I and my party (consisting generally of one
or two clerks and ten or more men) always enjoyed good health, sickness was unknown
among us, except sometimes being *weak for want of food*.

As for living without vegetables of any kind, people can and have done so for
years in Hudson's Bay, enjoying the best of health. As for scurvy, I never saw a case of it
during 40 years' residence in Hudson's Bay. A party of Hudson's Bay men, with the
usual portable provisions, 'pemmican,' could travel and winter years in the arctic regions
without thinking of or feeling the effects of scurvy.

R. CAMPBELL.

APPENDIX. No 29.

PAPER HANDED IN BY DR. RAE.

ARCTIC EXPEDITIONS.

SCALE of Sledging Rations recommended by J. Rae, where men had lived during winter on a mixed diet of salt and fresh provisions.

1 $\frac{1}{2}$ lb. pemmican	}	I should recommend <i>that no spirits</i> be issued as a ration either during the voyage or winter, prior to sledging.	
$\frac{3}{4}$ „ biscuit			
$\frac{1}{8}$ „ Edwards's potato			
$\frac{1}{4}$ oz. tea			
A quantity of extract of tea			
$\frac{3}{4}$ oz. chocolate			
2 „ sugar			
3 „ stearine			
1 „ spirits of wine			} per man for fuel
*1 „ lime juice			
1 $\frac{1}{2}$ „ preserved cranberries ; perhaps a little onion powder			
2 „ condensed milk			

1 pint or quart of brandy for each 8-man sledge as medicine.

JOHN RAE.

* The lime juice could be carried in flat tin bottles, of a size to hold three or four days' allowance for 8 men, and thawed every day by being placed over the kettles when cooking. These bottles would be thrown away when empty. I do not mean that the lime juice should be carried from England in these bottles.

NOTE—The above rations are almost identical in kind, although larger in quantity, with those used by my party in 1854, except that the lime juice and cranberries are additional.

APPENDIX No. 30.

PAPER HANDED IN BY SIR ALEXANDER ARMSTRONG, ON SCURVY
IN FORMER EXPEDITIONS.

No professional Returns of any kind were received from Dr. William T. Domville, Surgeon of the "Resolute," during her commission from 1852 to 1854. I have recently called on that officer for these Returns, but he is unable to produce them.

Those cases shown as occurring among the men of that ship, were specially noted by the Surgeon of the "North Star" after the crews of the "Resolute," and her tender, the "Intrepid," had joined her in the summer of 1854.

The Returns of the "Assistance" for 1850-51, although sent into office, cannot be found.*

To the "Intrepid" a portion of the crew of the "Investigator" was sent, amounting to about 20, as well as I can recollect, and the Returns do not distinguish the sickness of these men from that of her own ship's company. One case with symptoms of scurvy associated with hepatitis, which proved fatal, in a man of the "Intrepid," was reported by Surgeon R. C. Scott; the man had been about 106 days travelling with Commander M'Clintock; and I have reason to know that a case of bronchitis, with dropsy, in the same ship, which also proved fatal, was scorbutic.

As all the scorbutic, and a large portion of the other diseases, occurred in the "Investigator" during the third year of her commission, when the crew were on a very reduced allowance of food and lime juice, in fact in a state of semi-starvation, this will account for the relatively large amount of sickness.

It will be observed that all the other ships suffered from a class of diseases not usual in arctic regions, except when scurvy is present, which, with one exception, were prevalent on board the "Investigator" when the scorbutic taint was very general amongst the crew, and I am therefore disposed to infer that they may also have been of a scorbutic character on board these several ships, particularly as they generally occurred coeval with scurvy. How far the occurrence of these diseases may have been attributable to sledging, I have no means of judging, but if the fact could be ascertained, it is probable they occurred largely among those who had been sledging.

It is remarkable in this Return that dyspepsia occurred pretty extensively in all the ships except "Investigator," where causes for its occurrence were more likely to exist, from the fact that, during the last year of the commission, the scanty allowance of provisions were, for the most part, eaten in the raw state.

As polar service does not, as far as I know, favour the occurrence of this diseases I am disposed to think that it may have been rather an indication of the early symptom, of scurvy, which a longer sojourn in the ice would probably have more fully developed, and I recognised numerous cases which might have been considered dyspeptic, but they were really scorbutic, and so returned.

This Return only embraces the diseases of a suspicious character, which may have been scorbutic, during the period when these ships were actually in the ice.

The Returns regarding "Investigator" and "Enterprise," in 1848-49, cannot be accepted as accurate, as the journals of these ships are now with the Committee; the cases of scurvy do not appear to have been recorded, although it is well known that scurvy existed on board both ships.

A. ARMSTRONG,
Director-General.

February 24th, 1877.

* See, in foot note to the Return, information supplied by Dr. Donnet to the Committee.

RETURN of Cases of Scurvy and Diseases, probably of a Scorbutic Character, on Board the following Ships, whilst on Arctic Service.

	1848-49.		1849-50.		1850-51.			1852-54.			1853-54.			1850-54. *	
	Enterprise.	Investigator.	North Star.	Pioneer.	Resolute.	Intrepid.	Assistance.	Intrepid.	North Star.	Pioneer.	Assistance and Pioneer Men on Board North Star.	Intrepid and Pioneer Men on board North Star.	Investigator Men on board North Star.	Enterprise.	Investigator.
Scurvy	—	2	7	—	1	—	1	6	—	2	2	—	—	21	24
Rheumatism	10	13	9	—	9	5	—	15	8	9	1	1	—	12	15
"	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—
"	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—
"	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Edema	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dyspepsia	3	—	—	—	—	—	7	—	—	—	—	—	—	—	—
Diarrhoea	8	4	2	2	5	1	19	21	3	9	—	—	1	15	—
Debility	12	4	—	2	3	4	10	8	5	11	4	2	—	5	23
"	—	—	2	—	—	—	2	—	—	1	—	—	1	—	20
"	—	—	—	—	—	—	—	—	—	—	—	—	3	—	10
"	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4
"	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

* The "Enterprise" was three seasons in the Ice, and the "Investigator" four.

Note by Dr. Donnet.—The "Assistance," 1850-51, had 12 cases of rheumatism.

8 " oedema.

1 " dyspepsia.

None of these depended on scorbutic taint.

APPENDIX No. 32.

LETTER FROM CAPTAIN NARES TO THE SECRETARY OF THE ADMIRALTY ENCLOSING INFORMATION CONCERNING THE ISSUE OF LIME JUICE IN THE RECENT ARCTIC EXPEDITION.

SIR,

Stoneham House, Winchester, 10th November, 1876.

I HAVE the honour to enclose a communication from Fleet Surgeon Thomas Colan of H.M.S. "Alert" to the Medical Director-General in answer to certain questions he received from the latter concerning the issue of lime juice as a ration to the sledge crews of H.M.S. "Alert," and to add that, for a month previous to the start of the sledge parties, a double allowance of lime juice was issued to all on board.

During the severe weather in April and early May, lime juice was not issued to the travellers owing to the extra weight of fuel which would have been necessary for melting the required quantity of water.

Previous to the outbreak of scurvy, all the depôts laid out for the return of the travellers, which they would reach about the end of May with lightened sledges, were supplied with a ration of lime juice and extra fuel with which to melt it and the snow for water.

In this arrangement the example of the last Government expeditions was followed.

With regard to the consumption of food, I have the honour to report that during the winter neither the Officers nor the men consumed their total allowance of meat or bread, and on the departure of the travellers, they, as a body, did not recover their appetites for the first 10 or 12 days, after which time the strong men could have eaten much more than the sledging ration; while some few, who afterwards were the first to suffer, never recovered their appetite or eat their total ration.

The Officers report unanimously that when the scurvy made its appearance the appetites of all quickly diminished; thus assisting the disease to weaken those attacked, when such severe labour was demanded.

Doctor Colan was always very particular in representing the advantages of a continuous supply of lime juice.

I alone am responsible for the sledge crews not being supplied with it.

I have the honour to be, &c.,

G. S. NARES,

Captain R.N.

REPORT OF FLEET-SURGEON THOMAS COLAN, R.N., M.D.

(Enclosure in the above.)

SIR,

H.M.S. "Alert," Portsmouth, November 7th, 1876.

WITH reference to your letter 76/6991, dated the 2nd of November, respecting the outbreak of scurvy among the crew of this ship, I have the honour to report as follows:—

1. If lime juice was supplied to the several sledging parties for daily use while absent from the ship; and if so, in what quantity; and if not, that you will explain under what circumstances its issue was omitted.

The extended sledge parties which left the ship on the 3rd of April, 1876, with their supports, were not supplied with lime juice, save a small quantity taken by Commander Markham.

I deemed it prudent to speak to Captain Nares about sending lime juice away; but he deemed that it could not be done, unless other things considered absolutely necessary were left out. The weight and the amount of fuel necessary to melt the lime juice and the water for its consumption were reasons subsequently ascertained for its non-issue.

With the exception of a couple of minor sledge parties lime juice was issued to all after the scorbutic symptoms appeared, and the weather allowed it to remain in a fluid state. The quantity issued was generally 1 oz. a day.

2. If you will inform me, so far as you can do so, in regard to the scale of diet for the daily use of the travelling parties, if the men actually consumed the food issued, or what portion of it, and if it was not so consumed, I request that you will state any reason you can assign for its non-consumption.

I cannot, from personal observation, give you the full details on this subject, but as far as I could gather I conclude that, as a rule, the men at first did consume their food, that afterwards some ate less, and that many preferred the bacon to the pemmican.

The reasons for this failure and lessening of the appetite were, I believe, the gradual development of scurvy, the great fatigue from physical exertion, and the distaste to the same food never, or extremely rarely, broken by the consumption of any fresh meat or vegetables.

I have &c.

THOMAS COLAN, M.D.,
Fleet-Surgeon.

Sir Alex. Armstrong, K.C.B., LL.D., F.R.S., &c.

REPORT OF STAFF SURGEON BELGRAVE NINNIS, R.N., M.D.

SIR,

H.M.S. "Discovery," Portsmouth, November 4, 1876.

IN reply to your communication of the 2nd instant, relative to the outbreak of scurvy among the crew of H.M.S. "Discovery" whilst sledging, I have the honour to inform you that lime juice was not supplied to the sledging parties.

In conversation with Captain Stephenson, during the winter, relative to the advisability of sending lime juice in sledge journeys, I expressed my sense of its usefulness, but having previously gathered the information relative to the weight of the lime juice, the fuel necessary to thaw it, as well as the snow to mix with it, I did not think it my duty to urge its issue in the face of those more competent to judge of its necessity on travel, nor did I think that scurvy was likely to occur during sledging, as hitherto plenty of game has always been procurable.

As regards whether the men, when sledging, consumed the whole of their rations, I am informed that when in health they did so with one or two exceptions; but when their health began to fail, appetite failed also, until towards the end of the journeys the consumption was reduced to about half.

I consider this falling off to be due to the irritability of stomach and general depression of the nervous system, consequent upon the disease, coupled with the monotony of eating pemmican for many weeks without the possibility of a change.

I have, &c.

BELGRAVE NINNIS, M.D.,
Staff Surgeon.

Approved,

H. F. STEPHENSON,
Captain.

LETTER FROM SECRETARY OF ADMIRALTY TO COMMANDER-IN-CHIEF, PORTSMOUTH.

SIR,

Admiralty, November, 11th, 1876.

Captain Nares, of H.M.S. "Alert" having forwarded to my Lords Commissioners of the Admiralty a letter from Fleet Surgeon Thomas Colan addressed to the Director-General of the Medical Department in answer to certain questions as to the supply of lime juice to the sledge crews, and as to the scale of diet for the daily use of the travelling parties, I am commanded to signify their Lordships' directions to you to call upon Captain Nares to state what were the rations allowed to these parties, and the use that they made of each sort.

I am, &c.

ROBERT HALL.

Admiral G. Elliot,
Portsmouth.

ARCTIC EXPEDITION, TRANSMITTING REPORT OF DIET LIST, &c., FOR
SLEDGE PARTIES.*"Duke of Wellington," Portsmouth, 17th November, 1876.*Submitted to the Lords Commissioners of the Admiralty for their information, with
reference to your letter of the 11th November, 1876, M.

GEO. ELLIOT,

*Admiral.**Secretary of the Admiralty.*

DIET LIST, &c., ARCTIC SLEDGE PARTIES.

SIR,

*Stoneham House, Winchester, 16th November, 1876.*In obedience to your orders of the 13th instant, I have the honour to inform you
that the Diet Lists for the sledge parties of H.M.S. "Alert" and "Discovery" were as
follows :—

						lbs.	oz.	
Pemmican	..	..	..	..	..	1	0	
Biscuit	..	..	..	..	..	0	14	
Bacon	..	..	..	..	..	0	4*	
Potato	..	..	..	..	..	0	2	
Rum	..	..	..	..	..	..		$\frac{1}{2}$ gill.
Chocolate	..	..	..	..	..	0	1	
Sugar for ditto	..	..	..	..	..	0	$0\frac{1}{2}$	
Tea	..	..	..	..	..	0	$0\frac{1}{2}$ †	
Sugar for ditto	..	..	..	..	..	0	$1\frac{1}{2}$	
Stearine	..	..	..	..	..	0	3	} per man.
Spirits of Wine	..	..	..	..	..	0	1	
Tobacco	..	..	..	..	..	0	$0\frac{1}{2}$	
Salt	..	..	..	..	..	0	$0\frac{1}{8}$	
Pepper	..	..	..	..	..	0	$0\frac{1}{20}$	
Onion and Curry Powder	..	..	..	..	..	0	$0\frac{1}{4}$	

The weights dragged by each man, without including the officers, were :—

On leaving Ship.

Captain Markham	..	..	..	236 $\frac{1}{2}$ lbs.,	10 men.
Lieutenant Parr	..	..	..	235 "	7 "
Support Sledges	..	..	..	231 $\frac{1}{2}$ "	6 "
"	..	..	..	232 $\frac{1}{3}$ "	6 "

Captain Markham's party, after the support sledges left them, had to drag three
sledges with only two crews.

One was weighted 227 lbs., for 12 men out of the 15.

Second	"	232	"	"	7	"	} "	15.
Third	"	216	"	"	8	"		

Lieutenant Aldrich's party had to drag each 241 lbs. with 7 men.

Lieutenant Beaumont's party had lighter sledge loads; the heaviest weight each
man had to drag was 226 lbs.The support sledges used later in the season had much lighter sledges to drag, and
were consequently able to carry extra comforts.

I have, &c.,

G. S. NARES,

*Captain R.N.,**Commanding Arctic Expedition.**Admiral Geo. Elliot,**Commander-in-Chief.*

* Increased in some cases to 6 ounces, at request, in lieu of pemmican.

† Double allowance of tea was carried in lieu of rum.

REPORT OF MEDICAL DIRECTOR-GENERAL OF NAVY ON THAT OF CAPTAIN NARES OF 10TH NOVEMBER, 1876.

This Report would appear to be confirmatory of the opinion I expressed to their Lordships in my Report of the 13th instant, touching the question of, and the effect produced by, overtaxing the physical powers of the men, and depriving them of lime juice. Regarding the Diet List, I consider it suitable for the particular service, with this exception, that it would, in my opinion, have been more judicious to have so far modified the weight of the sledges, by slightly reducing the quantity of some of the articles, particularly that of sugar and rum, or, indeed, to have withheld both, more especially the latter, altogether, neither of them being articles of absolute necessity in polar travelling (except, perhaps, a small quantity of rum or brandy for medical purposes), and as recommended by me in the instructions of the 30th April, 1875, of which their Lordships are fully cognisant, and to have substituted lime juice, which was recommended to be sent with the sledge parties in the above-mentioned instructions, and which would, in my opinion, have averted the outbreak of scurvy which occurred.

A. ARMSTRONG,
Director-General.

23rd November, 1876.

REPORT ON THE OUTBREAK OF SCURVY IN THE ARCTIC EXPEDITION, BY THE DIRECTOR-GENERAL OF THE MEDICAL DEPARTMENT OF THE NAVY.

In compliance with their Lordships' directions of the 9th instant, LMM, desiring me to report on the opinions expressed in "Fleet-Surgeon Colan's Report as to the "cause of the occurrence of scurvy" among the crews of Her Majesty's ships "Alert" and "Discovery," composing the Arctic Expedition;

I now beg to state, for their Lordships' information, that I concur in the views expressed by Fleet-Surgeon Colan as to the causes he has mentioned for the production of scurvy among the crews of these ships, causes which are always present and inseparable from service in the arctic regions, when uncontrolled by efficacious antiscorbutic agents.

2. I find that a strict observance of the rules proposed by me, in a Memorandum, dated the 30th April, 1875, for maintaining the health and efficiency of the Expedition, drawn up in compliance with their Lordships' directions of the 23rd April, 1875, and forwarded by them for the information of the Commanding and Medical Officers of the ships, was attended with the best results, as nothing could well be more satisfactory than the health enjoyed by the respective ships' companies during the winter, and up to the period of the dispatch of the sledge parties from the ships.

3. Each of the men underwent a strict medical examination before being selected for the sledge parties, and any who appeared at all unsuitable for the work were withdrawn; and all who started were pronounced in good health and free from any semblance of scurvy, an opinion fully endorsed by Captain Nares in his Report of Proceedings.

4. I have no facts before me to show the weight of the sledges, or how far the men may have been absolutely overweighted at starting, or subsequently; or how far, assuming no excessive sledge weight, the difficulties they had to encounter may have led to the exhaustion, debility, and scurvy which supervened at such an unprecedentedly early period of the journey. I incline to the opinion that the physical powers of the men were overtaxed, and scurvy would thus early be produced when not counteracted by adequate antiscorbutic agency.

5. I find, on reference to Fleet-Surgeon Colan's Return, in giving a diet-list of the men during the sledge journeys, that it was a good and liberal scale of diet, but of which lime juice forms no part, although, foreseeing the great difficulties which might be encountered in the exploration of an unknown region of the Pole, its daily use among the sledging parties was strongly inculcated in my Memorandum already quoted.

6. I considered this departure from instructions so grave and unaccountable that I called on the Senior Medical Officers of the "Alert" and "Discovery" respectively for an explanation of the omission of this most valuable antiscorbutic agent from the daily diet of the sledge parties; and I herewith forward their replies, which have

been received by me this morning, otherwise this Report would have been forwarded sooner.* It will be seen that lime juice was not sent with the sledge parties, although its advantages were represented by these officers, who also state the reasons which were assigned for this serious omission.

7. After a long, and indeed an unprecedented period of continuous service in the arctic regions of several years duration, I was unhappily afforded the most undoubted and conclusive evidence of the great power and efficacy of lime juice, both as a preventive and curative agent in scurvy; and, looking to all the circumstances connected with the present outbreak and the causes stated by Fleet-Surgeon Colan, which in his opinion contributed to the production of scurvy, "in the absence of prophylactics"; I am forced to the conclusion that the want of lime juice in the diet of the men was the main cause, beyond all others, of the occurrence of the sudden and unexpected outbreak of scurvy which unfortunately took place.

A. ARMSTRONG,

Director-General.

13th Nov. 1876.

P.S.—Since the above Report was written, further papers have been forwarded to me by their Lordships, with reference to my application of the 9th instant for the weights dragged by each man in sledging, from which it appears that the opinion I ventured to express, in the absence of this information, in paragraph 4 of this Report, as to the men having been over-weighted, has been fully confirmed.

A. A.

14th Nov. 1876.

LETTER FROM CAPTAIN NARES, DATED 30th NOVEMBER, 1876, FORWARDED BY THE COMMANDER IN CHIEF AT PORTSMOUTH ON THE SAME DAY.

Sir,

H.M.S. "Alert," Portsmouth, 30th November, 1876.

The accompanying report (which I herewith return) upon the recent occurrence of scurvy among the crews of H.M. Ships "Alert" and "Discovery," by the Medical Director-General of the Navy, which I am directed to remark upon, is of such importance, opening as it does the whole question of similar attacks in former arctic expeditions, that I have the honor to request their Lordships will permit me to delay my full remarks until I have more leisure time at my disposal.

With reference to par. 2, I would state that, however satisfactory the health of the ships' company might have been apparently prior to their departure on the sledge journeys, I cannot think that they were so actually, and am rather of the opinion that the seeds of the disease were sown sometime previous to the men leaving the ship.

With regard to par. 4 and the postscript, I would observe that the weights dragged by the sledge crews were not more than had been the custom in previous expeditions.

The Medical Director-General was probably misled by the statement in Captain Markham's report that the total weights "were equal to 405 lbs. per man"—an impossible weight—it was explained elsewhere in Captain Markham's report that this was the weight to be transported, but that only half the weight was dragged by the men at any one time.

The only way the powers of the men could have been taxed more than those employed on former occasions, was in consequence of the increased difficulties of the road; instead of the usual continuous walk when dragging the sledges, a greater part of each day's journey had to be performed by the crew facing the sledge and hauling it forward by jerks a few feet at a time; this state of things however did not occur until after the first five or six days in the Northern and the Greenland parties, and was only occasionally experienced by the Western Division.

On the eleventh day after leaving the ship, John Shirley, Stoker, one of Captain Markham's sledge crews, was attacked with what we now know to be scorbutic symptoms; and on the following day George Porter was also attacked by the same disease.

This, in my opinion, tends to prove that some other cause as well as the absence of

* See letters of 4th and 7th November, pp. 377-8

lime juice helped to occasion the outbreak ; for I can scarcely hold to the opinion that twelve days' absence of lime juice would occasion such a sudden outbreak of disease.

On many former sledge journeys, the crews working on a similar diet, without lime juice for a considerably longer period, and unable to obtain fresh game, were not attacked so readily.

I have the honor, &c.

G. S. NARES,

Captain.

*Admiral George Elliot,
Commander-in-Chief.*

ATTACK OF SCURVY IN THE RECENT ARCTIC EXPEDITION.

SIR,

Stoneham House, Winchester, 14th December, 1876.

With reference to my letter of the 30th ultimo, on the subject of scurvy among the crews of the sledging parties of the recent expedition, I have the honour to request that you will lay the following further information before the Lords Commissioners of the Admiralty.

It will, I think, render the matter clearer if I place the facts, so far as possible, in the order of time.

I may first state that I served in the arctic expedition under Sir Edward Belcher, employed in the search for Sir John Franklin, and on that occasion I gained considerable practical experience of the details of sledge travelling, having commanded sledges on several occasions during the two seasons we were employed in the arctic regions.

For some time previous to leaving England, in May, 1875, I was in constant communication with Admiral Richards, Sir L. M'Clintock, and other officers distinguished in arctic exploration ; and I need hardly say that the question of the weights and dietary for the sledge parties, forming, as it did, one of the most important parts of the expedition, received much consideration.

From the time of the ship leaving England, I looked upon the health of the crews as a point second to none in importance. The issue of a daily ration of one ounce of lime juice was commenced at once, and not only was this ration issued, but it was consumed by the men every morning, under inspection at divisions.

During the exceptionally long winter through which we passed, the greatest care was taken to keep the men in good health. The ventilation of the ship, amusements, exercise of the officers and crews in the open air, and the dietary of the men, were points closely attended to, and by the arrival of the spring season, I had every reason to think that the crews were in a high state of health.

For a month previous to the setting out of the principal sledge parties, I directed that a second allowance of one ounce of lime juice should be added to the daily ration. This allowance was issued in the evening, but I did not, as with the morning allowance, cause it to be consumed in the presence of the officers. I was, however, satisfied, that the men were grateful for this extra allowance, and that as a matter of fact it was consumed.

The equipment of the sledges for the extended spring parties received my most careful consideration during the winter. In arranging this I was materially guided by what had been done on the former expeditions under Sir Robert M'Clure, Captain Austin, and Sir Edward Belcher, whose reports, &c., I had before me in the shape of Parliamentary Papers. Besides the information contained in these reports, I knew partly from personal experience, and partly from information obtained from Sir Leopold M'Clintock, that the quarter of an ounce of lime juice described by Captain Austin and Sir Edward Belcher as a daily ration for travelling parties, had in reality never been so treated ; neither had this ration, to my certain knowledge, been supplied to the sledges in the expedition in which I served ; for the parties out the longest time, and also those employed after the second winter, carried no lime juice whatever.

If carried by any of the sledges sent out by Captain Austin, owing to the necessarily limited supply of fuel, and also to the time required to melt it, it was never so used until the warm weather had set in.

The weight of the clothing, provisions, and general equipment of the sledges employed on the late expedition, was as nearly as possible similar to that of the sledges

employed on the above mentioned expeditions; and I found it impossible to reduce the weights below those given in my previous letter on this subject.

In deciding the important question of sledging rations, I was therefore in the following position. I had before me what had been done on former expeditions, from the sledging parties of which the men had always returned safely; and, as was generally believed by arctic officers and myself, without having experienced any attack of scurvy, for such a disease was not supposed either by executive or medical officers to have seriously attacked arctic sledge crews (I now realize that what is described in the Parliamentary Papers as "debility" was in reality but the commencement of scurvy).

I knew that every man, by the time of starting, would have been, from the double issue, as I may say, saturated with lime juice.

I knew that whereas whilst on board the men had been fed on salt meat every alternate day, when sledging no salt meat of any kind would be issued, with the exception of four ounces of bacon daily. On the other hand, I had the recommendation of the medical officers of the ships as to the advisability of sending lime juice if possible.

I had the observations of the Medical Director-General recommending that lime juice should be taken on the sledging parties, which observations had been sent to me for my information before I left Portsmouth.

I must here state that I did not look upon the recommendation of Sir Alexander Armstrong in the light of direct orders from the Admiralty. They naturally carried great weight with me, coming, as they did, from a medical officer of his high position and long experience, and nothing but what I regarded as imperative necessity would have decided me to disregard them.

In the position in which I then was, I decided, after giving the matter my most anxious thought, that lime juice should not form a part of the sledging rations; and my reasons for arriving at this decision were:—

In the first place, the extra weight which would have to be carried by the sledges by the ration of lime juice and by the amount of fuel necessary to melt it; secondly, and which was of equal if not greater importance, the amount of time which would have been required daily for preparing it, and which could be so ill spared; and, lastly, the fact that former sledge parties had performed their duties safely and effectually without any such supply.

I would further observe that I had made arrangements that all travellers on returning on board should receive a double allowance of lime juice, and that the parties starting from the ships as the summer advanced, when lime juice could be used without so large an expenditure of either time or fuel, and when the weights carried on the sledges were lighter, should be supplied with a daily ration of one ounce of lime juice.

From the foregoing their Lordships will perceive that it was not without due forethought that I acted as I did.

I may also mention that Admirals Richards and Sir Leopold M'Clintock, Captains Vesey Hamilton, Bedford Pim, and Haswell, will fully bear out my statements, that they never carried any lime juice on the sledges for use while travelling in April or the early part of May, with a daily ration of either pemmican or preserved meat; and, although I do not wish in any way to shelter myself under others, I would with confidence submit that each of those officers would have taken no other precautions than I adopted had they been in my position as commander of the late arctic expedition.

I cannot conclude this explanatory letter to their Lordships without stating that the thanks of all the members of the expedition are due to the Admiralty for the ample manner in which it was supplied with everything that could add to their comfort, or tend to keep them in health; and the outbreak of scurvy, which attacked not only those employed on the extended sledge parties, but men who were only absent from the ship and without a daily ration of lime juice for from seven to ten days, and who did not undergo any extra severe labour, is on those grounds the more inexplicable, but nevertheless to me a matter of deep regret.

I have the honor, &c.

G. S. NARES,

Captain, R. N.

APPENDIX No. 33.

RETURN OF SICK AND WOUNDED OF H.M.S. "ALERT," FROM 1ST JULY
TO 30TH SEPTEMBER, 1875.

Disease.	Cases remaining by last Return.	Added to List during Quarter.	Died.	Discharged to Duty.	Remain- ing on List at end of Quarter.	Number of Days' Sickness.
Syphilis, Secondary	2	..	2	..	37
Catarrh	1	..	1	..	7
Bronchitis	1	..	1	..	7
Dyspepsia	1	..	1	..	48
Colic and Constipation	1	..	1	..	10
Exhaustion and Cramp } from Sledge Work	..	2	..	2	..	16
Sprains	1	..	1	..	3
Totals	9	..	9	..	128

Number of all Ranks and Ratings on Board.		Movements of the Ship during the Quarter.		
Rank and Rating.	No. Borne.	Date Sailed from.	Date arrived at.	Remarks.
Captain or Commander ..	2	Lat. 63° 16' N.,	Godhavn, Disco,	The weather during the period of this Return has been, in general, fine. Snow fell at times, and strong winds blew occa- sionally. Pack and floe ice were abundant. The temperature gradually lessened.
Lieutenants	5	Long. 52° 39' W.,	July 6.	
Sub-Lieutenant	1	July 1.		
Naturalist	1	Godhavn, July 15.	Rittenbenk, July 16.	
Chaplain	1	Rittenbenk, July 17.	Proven, July 19.	
Fleet-Surgeon.. .. .	1	Proven, July 21.	Upervivek, July 22.	
Surgeon	1	Upervivek, July 22.	Carey Islands.	
Ice Quartermasters	3		July 27.	
Assistant Paymaster	1	Carey Islands,	Jensen Point,	
Danish Dog Driver	1	July 27.	July 28.	
Seamen, Stewards, Boys, &c.	39	Jensen Point,	Off Cape Isabella,	Thermometer. Fahrenheit, has been as follows :— For July, 40·884°. „ Aug., 32·30° „ Sept., 16·61°. giving an average for the Quarter of 29·931°.
Marines	8	July 28.	July 29.	
Engineers	2	Off Cape Isabella,	Off Brevort Island.	
Stokers	4	July 29.	Aug. 1.	
Esquimaux	1	Off Brevort Island,	Haye's Sound,	
		Aug. 4.	Aug. 4.	
Total	71	Hay's Sound,	Off Victoria Head,	
		Aug. 5.	Aug. 7.	
Average No. of all Classes } for the period	64·93	Off Victoria Head,	Franklin Tearce	
		Aug. 8.	Bay, Aug. 9.	
		Franklin Tearce	Dobbin Bay,	
		Bay, Aug. 11.	Aug. 13.	
		Dobbin Bay,	Off Cape Collinson,	
		Aug. 15.	Aug. 20.	
		Off Cape Collinson,	Bessils Bay,	
		Aug. 21.	Aug. 23.	
		Bessils Bay,	Discovery Harbour,	
		Aug. 24.	Lady Franklin	
			Strait, Aug. 25.	
		Discovery Harbour,	Lincoln Bay,	
		Lady Franklin	Aug. 29.	
		Strait, Aug. 27.		
		Lincoln Bay,	Winter Quarters,	
		Sept. 1.	Lat. 82° 27' N.,	
			Long. 61° 22' W.,	
			Sept. 1.	

REMARKS ACCOMPANYING THE NOSOLOGICAL RETURN OF
H.M.S. "ALERT," FOR MICHAELMAS QUARTER, 1875.

The ship's company were 36 days on salt provisions, and 56 on fresh and preserved.

Lime juice was issued for 92 days.

No certificates for wounds and hurts, or trusses, were issued.

During the quarter the general state of the health of the ship's company has been satisfactory. One officer and seven men of the "Discovery" were on board since the 26th August, making in all 70 persons borne since that date. Since leaving Godhavn, Disco, on July 15th, the ship was gradually worked to the northward through the Waiyat Strait, Baffin Sea, the Middle Pack from off Cape Shackleton, the North Water, Smith Sound, Kennedy Channel, Hall Basin, Robeson Channel, into the Lincoln Sea to Winter Quarters, in latitude $82^{\circ} 20' 21''$ N., longitude $61^{\circ} 22'$ W. The ice met with to the northward of Port Foulke was very heavy. The temperature, as a rule, gradually got lower, until, on the 25th of September, $+1^{\circ}$ Fah. was registered on board; after this it rose as high as 13° . Great care was taken to clothe the men properly as the weather got colder. The food was of good quality and a fair amount of vegetables was issued, some looms, fresh mutton, and musk-ox flesh served occasionally to break the routine of preserved and corned meats. The water used was condensed snow or ice water. Lime juice was issued regularly to persons on board. Soft bread was issued for 61 days. Stoves were gradually erected in different parts of the vessel, till at the close of September eight fires (including those of the galley and engine room bogey) were under way. A drying room was established in the extreme fore part of the lower deck. The temperature of the living deck, where the majority of the men slept, as taken morning and evening since the 6th of September, showed a minimum of 46° and a maximum of 65° , giving a mean of 55.98° Fah. A good deal of drip took place from the condensed vapour overhead, but the hammocks were kept as dry as possible. The men were exercised, when opportunity was afforded, on the floe and on shore in the forenoon, by having some work assigned them. On the last day of the quarter the ship was completely surrounded with ice, having the land (to which she was anchored) on her port side, and immense hummocks of grounded ice on her starboard. The bilges were kept clean and were disinfected with carbolic acid when necessary. The following sledge parties left the ship: (1) a dog-sledge party of eight, which remained away a few days; (2) a party of 21 officers and men with three sledges, and which was absent four days; (3) a dog-sledge party of four, which left the ship on the 22nd of September; (4) a party of 24 officers and men with three sledges, which left on the 25th of September; the two latter parties were away at the end of the quarter. The men of No. 2 party had to make a long march in a gale of wind, with heavy snow underfoot and drifting snow around them, and two of them suffered accordingly, viz., John Shirley, æt. 32, stoker-mechanic, who became completely exhausted about a mile from the vessel. He was placed on the sledge, given a little grog, wrapped up and brought on board, where he was restored and was right in a few days. He experienced a good deal of muscular cramp in both the lower limbs. Daniel W. Harley, æt. 27, captain of the foretop, was seized the day after his return with severe muscular cramp of the muscles of the chest, attended with depression of the circulation. His case required much attention. He was fit for duty in nine days. A man named John Hollins, æt. 27, R.M.L.I., was attacked with colic while away sledging, and suffered severely from it after coming on board. He had been for some time subject to it, but in a minor degree. A fifth sledge party, consisting of one officer and seven men of the "Discovery," left this ship on the 8th of September, returning next day. The officer, Mr. Wyatt Rawson, æt. 22, Lieutenant, suffered afterwards from a slight attack of bronchitis, and one of the men, Alfred Hindle, æt. 25, A.B., from catarrh.

The following case was on the sick list for 37 days: George Kemish, æt. 30, ward-room steward, was admitted on the 28th of July, suffering from dyspepsia, aguish symptoms, congestion of the liver, and constipation. He had had intermittent fever in China some years ago. For some time he kept an alehouse in England, where he drank a good deal of beer. Since leaving Portsmouth he worked hard as a steward, and by some means he managed to get drink, of which he partook too freely; he also smoked too much; the consequence was he broke down, and was very severely ill, so much so that his life was esteemed in danger for a time. The stomach was disordered, there was excessive pain in the bowels with constipation, and there was irritation of the

urinary organs. The patient got slowly better. During his illness he was seized with an epileptic fit. After 37 days he was discharged to duty. He was after a time again attacked with a fit, and there seemed little hope of his becoming the strong man he was. It was considered better for him to let him perform some duty than to let him mope on the sick list, care being taken that he should have no opportunity of getting at drink, and being strongly advised against smoking. There has been heavy mortality among the Esquimaux dogs. The casualties have been as follows : Left on the floe in the middle pack, 1 ; bitches died in pup, 5 ; dogs died in fits, 2 ; killed on account of fits, 3 ; killed, being too old, 2 ; ran away, 2 ; total, 16 ; remaining, 18. Healthy dogs were suddenly seized with a kind of tetanic spasm of the limbs, accompanied with lunacy. During the interval between the fits the dog would roam about quite unconscious of where he went, whether overboard, or on thin ice, on which in his sane state he would not venture. Sometimes he would fly at and bite other dogs, and would occasionally foam at the mouth ; costiveness appeared to be generally a prominent system ; food was usually refused ; some dogs on recovery would get bad again ; bitches in pup seemed to suffer most ; croton oil to relieve the constipation ; warm meat, soup, and also brandy appeared to do good. The exact cause of the fits is as yet unknown.

THOMAS COLAN, M.D.,
Fleet Surgeon.

Approved,
G. S. NARES,
Captain.

RETURN OF SICK AND WOUNDED OF H.M.S. "ALERT," FROM
1ST OCTOBER TO 31ST DECEMBER, 1875.

Disease.	Cases remaining from last Return.	Added to List during Christmas Quarter.	Died.	Discharged to Duty.	Remaining on List at end of Quarter.	Number of Days' Sickness.
Catarrh	6	..	6	..	37
Dyspepsia	1	..	1	..	2
Colic and Constipation	1	..	1	..	2
Phlegmon and Abscess	1	..	1	..	2
Frost-bite	12	..	8	4	479
Sprains	1	..	1	..	4
Totals	22	..	18	4	526

REMARKS ACCOMPANYING THE NOSOLOGICAL RETURN OF
H.M.S. "ALERT," FOR CHRISTMAS QUARTER, 1875.

The crew were 23 days on salt, 60 on preserved, and nine on fresh provisions. Lime juice was issued for 92 days, soft bread was issued for 66 days, and biscuits for 26.

During the period of this return the general state of the health of the officers and men has been satisfactory. There occurred however several cases of frost-bite, all of which took place amongst the sledge party, consisting of the crews and officers of three sledges which left the ship to proceed in a north-westerly direction, on the 25th of September, and returned on the 14th of October, after having had heavy work in the snow, some having fallen into the water, and all having been exposed to a temperature varying between 15° plus and 22° minus. Out of 24 persons 12 were frost bitten. The bites, numbering 43, occurred in the hands and feet, principally in the latter; some were very severe, deep sloughs or eschars being formed, leaving in some cases, on their removal, the last phalangeal bones exposed. Amputation of the last phalanx and part of the first of the left great toe in the case of Mr. William H. May, æt. 26, Lieutenant; of both phalanges of the right great toe in that of James Self, æt. 27, A.B.; and of the last phalanx of the great toe in that of Thomas Oakley, æt. 28, Gunner R.M.A., had to be resorted to, after the

lines of demarcation had been fully established. These three patients and William Malley, æt. 22, A.B., who had had several frost bites, all of which got well, save one in which the last phalanx of the right great toe was exposed, remained on the sick list at the end of the quarter. Every effort was made to cure these cases, but they would progress but slowly; the confinement between decks, the absence of daylight since they were put on the sick list, and the necessarily restricted range of diet, doubtless tending to this result, so that on the whole I have reason to feel satisfied at the progress made. The remaining eight cases were discharged to duty ere the 31st of December. While the ship was being prepared for winter quarters, the canvas housing spread, stoves erected, sides of ships banked up to some extent, &c., six cases of catarrh occurred, which soon did well, and but three cases (one each of colic, sprain, and phlegmon) were added to the sick list for the last two months, all of which got well.

A medical examination of the officers and men was held on November 1st and December 1st, which on the whole proved very satisfactory. We lost the sun on the 14th of October, and have been living in candle light and darkness on board since the housing was finished towards the end of October. The men have been worked and exercised on the floe, &c., whenever practicable, which, without doubt, has contributed to maintain the general good state of health; nevertheless some have become pale, and the appetites of several lessened. Theatrical performances and penny readings were got up, and tended greatly to the amusement of all. Christmas was passed and enjoyed by us very happily.

The vessel has been banked up and the deck covered with snow to about the depth of 12 inches; the awning spread so as to house us in comfortably, yet leaving curtains for ventilation; snow condensers built over hatchways, stoves erected in different parts of the vessel, up-takes made to carry away foul air, ladder ways arranged to keep out cold air, the men clothed well, good food issued, and lime juice taken under the inspection of an officer. Musk-ox flesh and mutton were given as often as our limited supply of such would admit. The ventilation was kept so pure that the test for carbonic acid made of the air taken from the living deck, some time after the men had been in their hammocks, was always found to be under one per cent. The beams and lower decks were kept fairly dry. The mean temperature of the lower deck, including Captain's cabin, ward room, steerage, and mess-deck, excluding drying room (the highest temperature of which was 109°), was, for between two and three months, +48·41°, the mean of the men's mess deck itself +49·7°. The quarterly mean of the external air was —17·86°. The absence of gales of wind has been most beneficial, as it enabled us to be on the floe longer and oftener than if the opposite were the case. Altogether I am happy to be able to report that the year 1875 has closed upon us as well as could be expected. The water used has been melted ice, and was of good quality. The engine room bilges, the stokehold and screw alley bilges were kept in a wholesome state, carbolic acid being used when necessary.

THOMAS COLAN, M.D.,
Fleet-Surgeon.

Approved,
G. S. NARES,
Captain.

RETURN OF SICK AND WOUNDED OF H.M.S. "ALERT," FROM
1ST JANUARY TO 31ST OF MARCH, 1875.

Disease.	Cases remaining from last Return.	Added to List during Lady-day Quarter.	Died.	Discharged to Duty.	Remaining on List at end of Quarter.	Number of Days' Sickness.
Dyspepsia .. .. .	..	2	..	2	..	7
Colic and Constipation .. .. .	..	1	..	1	..	9
Frost-bite	4	1	..	4	1	108
Debility .. .. .	..	1	..	1	..	40
Totals	4	5	..	8	1	224

Number of all Ranks and Ratings on Board.			Movements of Ship during the Quarter.		
Rank and Rating.	No. Borne.	Date Sailed from.	Date Arrived at.	Remarks.	
Captain or Commander ..	2	Remained in Winter Quarters off Grant Land.		The weather during the period of account has been in general fine; but few heavy breezes of wind were experienced, and the fall of snow was not very heavy. The average or mean temperature, counting the days astronomically, was— January — 29·33° February — 38·25° March — 39·95° Giving for the Quarter an average or mean of 35·85°. Lowest temperature recorded, — 73·72°, on March 3rd.	
Lieutenants	5				
Sub-Lieutenants	1				
Chaplain	1				
Fleet Surgeon	1				
Surgeon	1				
Ice Quartermasters	3				
Naturalist	1				
Seamen, Stewards, Boys, &c.	39				
Marines	8				
Engineers	2				
Stokers	4				
Esquimaux	1				
Interpreter (a Dane) ..	1				
Total	70	Latitude 82° 27' 1" N. Longitude 61° 22' 0" W.			
Average No. of all Classes for the period .. }	70				

REMARKS ACCOMPANYING THE NOSOLOGICAL RETURN OF
H.M.S. "ALERT," FOR LADY QUARTER, 1876.

No certificates for wounds or hurts, or trusses were issued. The crew were 25 days on salt provisions, three on fresh, and 63 on preserved. Lime juice was issued for 91 days, and soft bread for 82.

During the quarter the general state of the health of the officers and ship's company has been very satisfactory. But five persons, out of seventy, were put on the sick list. One case, that of George Kemish, æt. 30, wardroom steward, who had previously suffered a good deal (see Nosological Return of Michaelmas Quarter) from a complication of diseases aggravated by his own misconduct, now again became ill, suffering from great debility, drink having a good share in causing such a state. He however, after a time, got well again. The most severe case was that of Neil Christian Petersen, æt. 37, interpreter for the Esquimaux language, a Dane, who having started with a dog-sledge and two officers on the 12th of March, to endeavour to reach the "Discovery" in Lady Franklin Strait, and having been exposed to wind and to cold between 26° and 32° below zero, got cramp in the stomach and legs, congestion of the lungs, and was severely frost-bitten in both feet. His state was so bad as to induce the officers to return to this ship, which they did on the fourth day from setting out, having placed the man on the sledge and tended him very carefully. On being brought on board he was undergoing great dyspnœa. Both feet were gelid and hard, so in great measure were the hands and fingers, and the tip of the nose was raw, all from frost-bite. After treatment circulation was restored in the hands and the afterparts of the feet, but the foreparts of the latter were irretrievably destroyed. With great care and attention the congestion of the lungs and subsequent bronchitis were subdued, and on the 25th and 26th of March, ten and eleven days respectively after being brought on board, I removed the foreparts of both feet by amputation through the tarso-metatarsal joints, the second metatarsal bone being sawn through, and in the right foot part of the internal cuneiform bone. Considering what the man had gone through on the journey and after his return, both before and after the operation, he was doing as well as could be expected at the end of the quarter, but he had received a great shock. The sun was seen on the 2nd of March, after an absence of 142 days, the longest period on record. The greatest cold ever recorded in the meteorological tables of Arctic ships was experienced, on the 3rd of March, when the temperature was as low as 73·72° below zero. The mean temperature from 5 a.m., March 3rd, to March 4th, at 4 a.m., was 70·31° minus. From 10 a.m., February 29th, to 6 p.m., March 5th, 129 hours, the temperature never rose above 60° minus, and the mean

temperature for that time was 66.29° minus. The mean temperature from February 28th to March 11th, 13 days, was 58.98° below zero. For the same length of time I am not aware of such a low average temperature having been ever recorded in arctic ships. The temperature between decks gave an average of 50° . The ventilation was free, there being sufficient up-takes and down-takes to admit of the change of air. The condensation and drip were sometimes abundant, but care was taken to keep the latter wiped up from time to time. The test for carbonic acid made at times of the air of the men's or living deck, after the men had been some time in bed, never gave as high as one half per cent. The drying room was used for the men to wash in and to dry their clothes. Lime juice was carefully issued, and for some time an extra allowance was given in the afternoon to those who wished it, preparatory to sledging operations. Good warm clothing (seal skin being generally used as outside clothing in the open air) was worn. The diet issued was good, and contained a judicious amount of vegetables, including fruits and pickles, but we were only able to have four meals of musk ox flesh and one of mutton during the quarter. A portion of musk-ox meat had to be condemned owing to its extremely musky odour and taste, and was used for the dogs. School was held: "Thursday Pops," including lecture from officers, and theatrical performances came off with *éclat*. Exercise in work or otherwise was taken, and good fellowship reigned throughout the ship. A monthly inspection into the health of officers and men, and another of those required for sledging, were held, and the result, by the blessing of God, has been that the day after the sun was seen there was not a person upon the sick list, and at the end of the quarter but one (a case of frost bite) was on the list. The housing was removed from the upper deck on the 13th and 14th of March, save from the forecastle and forepart of the deck. The few remaining dogs did well during the quarter. The dog-sledge "Clement Markham" left the ship for the "Discovery" with two officers, two seamen, and seven dogs.

The water under the ship's bottom remained fluid all the quarter. This season's ice attained the thickness during the winter of 6 feet $3\frac{5}{8}$ inches. The drinking water made from ice taken from a floe was good.

THOMAS COLAN, M.D.,

Fleet-Surgeon.

Approved,
G. S. NARES,
Captain.

RETURN OF SICK AND WOUNDED OF H.M.S. "ALERT," FROM
1ST OF APRIL TO 30TH OF JUNE, 1876.

Disease.	Cases remaining from last Return.	Added to List during Quarter.	Died.	Discharged to duty.	Remaining on List at end of Quarter.	Number of Days' Sickness.
Scurvy .. ..	..	38	1	10	27	843
Dyspepsia .. ..	..	1	..	1	..	41
Frost-bite	1	1	1	1	..	59
Contusions .. ..	..	1	..	1	..	23
Totals	1	41	2	13	27	939

Number of all Ranks and Ratings on Board.		Movements of the Ship during Quarter.		
Rank and Rating.	No. Borne.	Date sailed from.	Date Arrived at.	Remarks.
Captain or Commander ..	2	Remained in Winter Quarters. Latitude 82° 27' 1" N. Longitude 61° 22" W.		The weather during the quarter has been in general fine. Snow fell at intervals and occasionally rain. There occurred but few breezes of wind. The cold was severe at times in April. The average height of the thermometer has been as follows:— April −17·42° May +11·08° June +32·28° Giving a mean for the Quarter of +86·3°.
Lieutenants	4			
Sub-Lieutenants	2			
Chaplain	1			
Fleet-Surgeon	1			
Surgeon	1			
Ice Quartermasters	3			
Assistant Paymaster	1			
Naturalist	1			
Seamen, Stewards, Boys, &c.	39			
Marines	7			
Engineers	2			
Stokers	4			
Esquimaux	1			
Interpreter for Esquimaux ..	1			
Total	70			
Average No. of all Classes for the period	66			

REMARKS ACCOMPANYING THE NOSOLOGICAL RETURN OF THE SICK AND WOUNDED OF HER MAJESTY'S ARCTIC DISCOVERY SHIP "ALERT" BETWEEN 1ST APRIL, 1876, AND THE 30TH JUNE, 1876.

Fleet-Surgeon THOMAS COLAN, M.D., Surgeon E. L. MOSS, M.D.

No certificate for wounds or hurts, or trusses were issued.
The crew were 36 days on salt provisions and 55 on preserved.
Lime-juice was issued for 91 days, and soft bread for 66.
(Commissioned April 15th, 1875.)

The quarter has, I regret to state, been an exceptional one. It has been marked with two deaths. One from the effects of cold (frost-bite), the other from scurvy; and thirty-eight persons were placed on the sick-list with the last-named disease, including three men of the "Discovery."

Neil Christian Petersen, æt. 37, interpreter for the Esquimaux language (a Dane), of whose case there is a short notice in last Return, while on a dog-sledge journey to the "Discovery," in the month of March, was most severely and terribly frost-bitten in the hands and feet, besides suffering from congestion of the lungs. His state was so bad *en route* as to necessitate his being brought back to the ship, where he arrived in such a condition of prostration, dyspnœa, and frost-bite, that his life was despaired of.

By careful treatment the hands and fingers were restored, as were also parts of the feet; but the foreparts of the latter were irretrievably destroyed. After the lungs were improved, and the man was sufficiently strong, assisted by Dr. Moss, I removed by amputation the mortified portions of both feet which included all in front of the tarsal bones. Good flaps were formed, and the stumps did well for some time; but long confinement, and most probably a scorbutic diathesis, told on the system, and, notwithstanding all that could be done, in the almost total absence of fresh food, the man died from exhaustion two months after he received the injuries. A more detailed account of the case is given in my letter to the Director-General of July 4th, 1876.

The appearance of scurvy amongst us was a sore check to our hitherto prosperous state, and though but one case died, yet its severity with some was so great, and its

numbers comparatively so numerous, it appeared in our small ship a heavy calamity, and it taxed our energies to the utmost to provide suitable nourishment, accommodation, and attendance for the sick.

During the monthly medical inspections held during the winter the state of health of the officers and men, as a very general rule, appeared so high, that no suspicion was entertained that scurvy would attack them in the spring. On the 24th of March the following report was made by me to the Captain of the condition of those on board required for sledging :—

Sledge No. 1 (1 Officer and 9 Men).

Commander A. H. Markham	In good health.
Thomas Rawlings, captain forecastle	Do.
Thomas Jolliffe, captain maintop	Do.
John Shirley, stoker-mechanic	Do.
John Radmore, acting carpenter's mate	Do.
William Ferbrache, A.B.	Do.
Thomas Simpson, A.B.	Do.
Daniel W. Harling, captain foretop	Do.
Alfred R. Pearce, A.B.	Do.

Has a cicatrix or scar from frost-bite on left great toe. It would be advisable not to send this man on an extended sledge journey.

Sledge No. 2 (1 Officer and 7 Men).

Lieut. Pelham Aldrich	In good health.
Joseph Good, boatswain's mate	Do.
Adam Ayles, 2nd captain foretop	Do.
Thomas Stubbs, stoker-mechanic	Do.
Elias Hill, private R.M.L.I.	Do.
James Doidge, captain foretop.	Do.
James F. Cane, armourer	In good health

at present, but has suffered a good deal of late from hoarseness and cough ; it would be advisable not to send him on an extended sledge journey.

Sledge No. 3 (1 Officer and 7 Men).

Lieut. A. C. C. Parr	In good health.
Edwin Lawrence, captain forecastle	Do.
Reuben Francombe, A.B.	Do.
John Hawkins, cooper	Do.
Wm. Maskell, A.B.	Do.
George Winstone, A.B.	Do.
John Pearson, A.B.	Do.
George Porter, gunner R.M.A.	Do.

Sledge No. 5 (1 Officer and 7 Men).

Surgeon E. L. Moss, M.D.	In good health.
John Thors, ice-quartermaster	Do.
George Cranstone, A.B.	Do.
William Wolley, A.B.	Do.
Wm. Wood, colour sergeant, R.M.L.I.	Do.
David Mitchell, A.B.	Do.
John Hollins, private R.M.L.I.	In good health

but is subject to severe and continuous colic, which prostrates him for some days. Is an unsafe man for sledging.

Sledge No. 6 (1 Officer and 7 Men).

Engineer George White	In good health.
David Deuchars, ice-quartermaster	Do.
Robert Joiner, L., stoker-mechanic	Do.
James Self, A.B.	Do.

Has lost right great toe from frost-bite, and has scars on toes from others. It would be advisable not to send him an extended journey.

Wm. Malling, A.B.	..	..	..	..	..	In good health.
Has scars on toes from frost-bites. It would be advisable not to send him sledging till the weather be more moderate.						
J. W. Hunt, wardroom cook	..	..	..	..	..	In good health.
Thomas Smith, private R.M.L.I.	..	..	..	..	..	Do.
Arthur Norris, carpenter's crew.	..	..	..	..	..	Do.

Men of the "Discovery" who had wintered on board this ship:—

George Bryant, captain of the maintop	..	..	..	..	In good health.
James Hand, A.B.	..	..	..	..	Do.
Thomas Chalkley, A.B.	..	..	..	..	Do.
George Stone, A.B.	..	..	..	..	Do.
Alfred Hindle, A.B.	..	..	..	..	Do.
Elijah Rayner, gunner R.M.A.	..	..	..	..	Do.

THOMAS COLAN, M.D.,
Fleet-Surgeon.

H.M.S. "Alert."

March 24th, 1876.

Changes were made in the foregoing list; men transferred for some time after.

On the 3rd of April, when the 7 sledge parties left the ship, and they consisted of 6 officers and 47 men, a finer body it would, I am of opinion, be difficult to get together; and few men could be found that could have accomplished what they did under the circumstances. Each party was provided with medicines and necessaries to meet any casualty that might occur, each officer having in his sledge-book most explicit instructions as to their use, the captains of the sledges having been instructed in the use of the more harmless of them. The great and difficult task of trying to force a passage across the frozen sea towards the Pole was undertaken by Commander Markham, Lieutenant Parr, and 15 men; the exploration of the land to N.W. having been allotted to Lieutenant Aldrich, supported by Lieutenant Giffard. Dr. Moss and Mr. White supported the advanced parties to about 83° N.

The sledge work was most difficult and trying from the commencement, so much so that double banking was of common occurrence. The passage over the frozen sea northwards entailed work of the most arduous nature, roads having generally to be cut with pickaxes, through the hummocks, and loads drawn through these, which involved journeying over the same ground as much as five times a-day, the men working often 11 hours a-day, and then making but $1\frac{1}{2}$ or 2 miles a-day. But little comparatively smooth ice was met with, endless ridges of hummocks or floebergs being constantly encountered.

On the 13th of April, *James Berrie*, æt. 34, ice-quartermaster, who had been sent back from his sledge on account of not being strong enough for pulling, was placed on the sick-list with debility. The case resulted in scorbutic debility, and rigidity of the hamstrings. This man had been on the list during the winter with dyspepsia and debility, but only for 4 days.

On April 28th, *John Simmonds*, æt. 28, second captain of the maintop, who had made a dog-sledge journey to the "Discovery" and back, and to Greenland across Robeson Channel and back, was put on the sick-list with œdema and discoloration of the left leg, which eventuated in sore gums, and rigidity of the hamstrings.

Next was admitted on the 25th April, *Vincent Dominique*, æt. 34, ship's cook, who had been on the list with a frost-bite, contracted on a sledge journey. He exhibited sponginess of the gums, with subsequent debility, accompanied with swelling and discoloration of the left leg.

On May 1st, *David Deuchars*, æt. 30, ice-quartermaster, who had been two sledge journeys to near Cape Joseph Henry and back, was entered with œdema of both legs, followed by debility, sore gums, and rigidity of the hamstrings.

On the same day, *George C. Burroughs*, æt. 31, ship's steward, who had been on the sick-list since April 8th, with injuries of the lower part of the thighs, caused by the pressure of a heavy cask of provisions, exhibited swollen and tender gums, some lividity and hardness of part of the right leg, accompanied with debility.

On May 12th, *John Thors*, æt. 36, ice-quartermaster, who had been two sledge journeys to near Cape Joseph Henry and back, was admitted with tender gums, and slight

bronchitis, followed by livid blotches on both thighs and legs, with debility, and rigidity of the hamstrings.

On May 20th, *Benjamin Wyatt*, æt. 25, A.B., of the "Discovery," who had been across the Straits to Polaris Bay and back to that ship, and from her to this vessel, was placed on the sick with swollen and tender gums, and pain in the right thigh, which resulted in rigidity of the hamstrings.

On the same day *James F. Cane*, æt. 24, armourer, who had been on a sledge journey to near Cape Joseph Henry and back, was admitted with a swollen ankle and sore gums.

On the 24th of May, *William Lorrimer*, æt. 26, A.B., who was taken ill (doubtless with scurvy) while on the second journey with Lieutenant Giffard with a dépôt for Lieutenant Aldrich, and who had to be left in a snow hut with a companion for 5 days, and brought back on a sledge, was admitted with debility, and swollen gums, accompanied with rigidity of the hamstrings.

On the same day *William Wolley*, æt. 25, A.B., who had performed similar work, and looked after Lorrimer in the hut, came on the list with swollen gums and ankles, resulting in œdema of the right leg. This man had to be excused from sledging most of the return journey.

On the 25th of May *Frederick*, æt. about 28, Esquimaux, who had been employed with the dog sledge, was admitted with swelling of the left leg, and some rigidity of the hamstrings.

On the same day *Robert Symonds*, æt. 25, A.B., who had been two sledge journeys with Lieutenant Giffard, came on the list with livid blotches on both legs, and right popliteal space, resulting in sore gums and rigidity of the hamstrings.

On May 30th *Thomas Smith*, æt. 27, private R.M.L.I., who had been 3 sledge journeys to near Cape Joseph Henry and back, and one journey across the channel to Greenland and back, was admitted with slightly sore gums, lividity, and swelling of the right leg, which resulted in debility, and much swelling of the leg.

Next followed on June 1st, *Thomas Chalkley*, æt. 24, A.B. of the "Discovery," who had passed the winter in this ship, and had gone on a sledge journey to near Cape Joseph Henry and back, then to Greenland across the straits, where he travelled for a week with Lieutenant Beaumont to the eastward, then back to Polaris Bay and across the channel to his own ship, and from her to this vessel, having been carried on the sledge part of the latter journey, was admitted with sponginess of the gums, partial lividity of the thighs and legs, with debility.

On June 20th, *Daniel Girard*, æt. 27, A.B. of the "Discovery," who had been on a sledge journey up Lady Franklin Strait, also across the channel to Polaris Bay and back to his own ship, and from her to this vessel, was admitted with sore gums, and slight rigidity of the muscles of the left thigh.

Late on the night of the 13th, and early on the morning of the 14th of June, the party under Commander Markham returned to the ship, after 72 days' absence, with the exception of *George Porter*, æt. 27, gunner, R.M.A., who had died on the floe, probably from hydrothorax, supervening on scurvy, on the 8th of the month. All except three men, who pulled a sledge to the ship, had to be brought in on sledges. They had all been attacked with scurvy, which commenced on the outward journey, and some of them so badly, that Lieutenant Parr had to make a forced march of 30 miles to the ship to procure assistance. This was at once sent. Dr. Moss proceeded ahead with Lieutenant May and the dog sledge, while Captain Nares, with two other sledges, followed.

I dispatched medical comforts of different kinds, which proved of great benefit to the sufferers, whom Dr. Moss attended with great care, arranging the manner in which they were sent in, and himself standing by the worst cases. Captain Nares with the greatest care, organised and superintended all matters connected with the relief. After seeing the cases carefully removed into the ship, I had the worst of them placed in beds in the side berth, in cots in the steerage, and in beds placed on the floor of the latter and of the living deck. The cases of hydrothorax were cautiously watched and treated, while diarrhoea and sudden exertion were guarded against, lest fatal syncope should ensue. In addition to the medical treatment, careful dieting was adopted, calf foot and apple jellies, jam, marmalade, egg-flip, extract of mutton as soup, milk, rice, boiled fowl, oysters, vegetables, particularly potatoes, fresh bread, port wine, beer, and sherry were given; while lime-juice was administered as freely as I deemed the state of the stomach would admit, or the exigency of the case demanded. The few pounds of English mutton at my disposal were given to the cases most in need of such. Watches were established, the nurses being particularly warned to place the bed pans under the men in bed, thereby

obviating the danger of their sitting up. Dr. Moss and myself were constantly on the look out for any emergency or complication that might arise.

The following are the names with the prominent symptoms of the 14 men (the latter being those exhibited on return on board) :—

- John Pearson, æt. 23, A.B., sore gums and rigid hamstrings.
- John Shirley, æt. 23, stoker, mechanic, debility and depression, dyspnœa, sore gums, discoloured knees, and rigid hamstrings.
- Edwin Lawrence, æt. 27, captain forecastle, sore gums and swollen legs.
- Thos. Rawlings, æt. 33, captain forecastle, debility, sore gums, and rigid hamstrings.
- Daniel W. Harley, æt. 33, captain foretop, sore gums, livid and swollen legs.
- Thomas Jolliffe, æt. 35, captain maintop, sore gums, livid and swollen legs.
- John Radmore, æt. 32, acting carpenter's mate, slight rigidity of the hamstrings, with livid blotches.
- George Winstone, æt. 20, A.B., œdema of the legs, with coloration.
- William Maskill, æt. 23, A.B., rigidity of the legs.
- Thomas Simpson, æt. 23, A.B., hydrothorax, dyspnœa, sore gums, and rigid hamstrings.
- William Ferbrache, æt. 23, A.B., hydrothorax, sore gums, and swelled legs.
- Alfred R. Pearce, æt. 27, A.B., sore gums, hæmorrhoids and slight rigidity of the hamstrings.
- John Hawkins, æt. 38, cooper, hydrothorax, sore mouth and gums, with weakness of the legs.

Commander Markham, though feeling well and capable of work, exhibited slight livid blotches on the thighs and legs.

Lieutenant Parr, though wearied after his long and fatiguing march, was able to go about next day, but exhibited petechiæ on both legs, with abrasions on the feet from chafing of the foot-gear.

On 17th June, William Ellard, æt. 27, private. R.M.L.I., who had been both journeys with Lieutenant Giffard, and also with the relief party to near View Point, was admitted on the sick list with the sore gums, and rigidity of the muscles of the inside of the thighs.

Ere long, another emergency had to be met, Lieutenant Aldrich's party, which had been away for 84 days, returned to the ship on the 25th of June, having been helped in from near Cape Joseph Henry by Lieutenant May and 3 men with a dog sledge. The party consisted of Lieutenant Aldrich and 7 men. All the latter had scurvy, though some comparatively slightly, the officer declaring himself well. Medicine and comforts had been sent them; most of the cases were placed in cots and beds in the steerage, and treated in like manner to those described above.

The following are the names of the 7 men, with the principal symptoms they exhibited on return on board :—

- Joseph Good, æt. 33, boatswain's-mate, hydrothorax, sore gums, and swollen legs.
- Adam Ayles,* æt. 26, captain foretop, slight rigidity of the hamstrings of the left leg.
- James Doidge, æt. 28, captain forecastle, sore gums, rigid hamstrings, discoloured thighs and legs.
- David Mitchell, æt. 25, A.B., sore gums, swollen and discoloured legs.
- Henry Mann, æt. 23, shipwright, hydrothorax, sore gums, livid blotches on legs, and rigid hamstrings.
- Thomas Stubbs, æt. 25, stoker mechanic, hydrothorax, sore gums, swollen and discoloured thighs and legs.
- William Wood, æt. 32, colour-sergeant R.M.L.I., hydrothorax, sore gums, swollen legs and ankles.

On consultation with Dr. Moss, every means was discussed for the purpose of checking the progress of the scurvy, and those adopted proved so far successful that

* This man was equal to any work all through the journey out and home, and, with Lieutenant Aldrich, pulled his sledge to the ship.

at the closing of the quarter, those on the sick list, numbering 27, were doing fairly, and 10 had been discharged to duty.

Careful dieting, consisting of the preserved food on board, a little fresh mutton, a few geese and ducks, with a hare (I having been able to give the worst cases fresh meat for some days, and all the sick the same for two days), together with wine and beer, and the free exhibition of lime-juice effected a good deal.

The only fresh vegetable was a little mustard and cress, which, in a manufactured soil, I had succeeded in raising (having done so all through the winter with much difficulty).

The weather was too severe to allow of any seed being sown in soil in the outer air up to the end of the quarter (though that growing between decks was benefited by being exposed to the sun for a time).

The temperature in the shade on the 30th of June showed a maximum of 39° , a minimum of 32° . Not a scrap of sorrel or scurvy grass was to be found on shore, in the few places clear of snow, and no large game, and but very little small, could be procured.

The men, as well as the officers, not on the sick list, were placed on a double allowance of lime-juice and potatoes from the 16th of June, and preserved meat was issued daily since the 22nd of May, and beer once a week since 22nd of June.

The remote and essential cause of this outbreak of scurvy must be attributed to the absence and deprivation of fresh vegetable food, the substitutes for which—preserved vegetables and lime-juice—though the latter was issued in the quantity recommended, during the winter to each person under inspection, and with the greatest care, seemed to have failed in warding off the scorbutic diathesis, if such was established before the spring.

Any one or more of the following may have proved the predisposing cause or causes of the outbreak :—

1. *The long absence of the sun for a period of 142 days, and the living between decks in darkness, or in candle or lamp-light, from the 11th of October, 1875, to the 3rd of April, and for those remaining on board after the sledge parties left on that day, till the 22nd, both periods, I believe, unprecedented in arctic service, and most probably never passed before by any number of men.*

2. *The great cold to which the men were exposed for a portion of the winter, though warmly clad, in taking the exercise in the open air absolutely necessary for their health, and even their existence, a cold which necessitated at times and often a change from the inner to the outer air of 120° , and which reached at one time the extraordinary depth of $73^{\circ} 72'$, minus (nearly 106° below freezing-point, the mercury being frozen with a range of temperature between $41^{\circ} 58'$ and $73^{\circ} 72'$ minus, with the exception of 12 days between the 20th of January and 11th of March. The following epitome gives the state of cold experienced for some time in February and March :—*

The mean temperature from February 28th to March 11th, was $58^{\circ} 98'$ minus.

From 10 o'clock a.m. February 29th, to 6 o'clock p.m. March 5th, the temperature never rose above 60° minus, the mean temperature for that time being $66^{\circ} 29'$. The lowest mean temperature from 5 a.m. March 3rd to 4 o'clock a.m. March 4th, was $70^{\circ} 31'$ minus, the minimum being $-72^{\circ} 73'$. The lowest mean temperature from 7 p.m. March 2nd to 6 a.m. March 4th, was $69^{\circ} 93'$ minus.

3. *The long abstinence from fresh meat, 14 dinners of which the ship's company have only had since the 1st of September, 1875.*

4. *The drip from the condensed vapour between decks, arising from the galley, and 70 human beings, which, if allowed to freeze, would entail a temperature dangerous, because of its likelihood to cause catarrh, bronchitis, &c., from its lowness, and which, if dried up by heat, would render the atmosphere unhealthy by becoming too dry, or lessen the amount of oxygen entering the lungs.*

5. *The double allowance of spirit (rum) allowed.*

6.* *The absence of lime-juice on the extended sledge journeys, and on all the early spring journeys, as also of fresh meat.*

The exciting cause of the outbreak I can only attribute in general to the *great physical labour* undergone in sledging—labour which, in the case of the passage over the hummock-ridden sea towards the Pole, could, I am firmly convinced, only be performed by men such as we had.

The fact of some individuals having broken down early in the work does not, I think, invalidate this statement, for in the best selected body of men there will be some

* Save a couple of bottles taken by Commander and Lieutenant Parr.

who can only be found incompetent on trial, and whose precise state cannot be ascertained previously. It should be remembered, also, that many men in the ship had never (and would never in the ordinary course of service have) been exposed to very great physical exertion, prolonged, day after day, as stokers, carpenters, and cooks, and yet some of these did nobly under the circumstances.

It was absolutely necessary in order to carry out the purposes of the expedition, that as many men as possible should be sent sledging, and this was done, and had to be done at some risk, a risk which was voluntarily undertaken by all.

The endeavours to keep all on board in a state of health during the long winter were unceasing. A temperature averaging close on 50°, was kept up on the lower deck, and over 50° on the living deck. Ventilation was carried out to the extent the cold of the external air would admit.

The respired air was kept so pure that at the time the living deck was most crowded, *i.e.*, after the men had been some hours in their hammocks, it would yield less than one-half per cent. of carbonic acid.

The drip was carefully looked after and wiped up, and any damp clothing or hammocks when detected were immediately sent to the drying room, where they quickly got dried. I myself constantly visited the living deck, felt the bed-clothing, took the temperature, examined the state of the beams and deck, suggesting any remedy that I might deem necessary,

Lime-juice in the proportion of 1 oz. daily was issued most strictly.

The meat daily issued was alternately corned and preserved, corned pork and beef following each other every second day.

The quantity of meat allowed was 1 lb. daily up to October 16th, and since that date to May 22nd, 1 lb., with a quarter of a pound of corned pork every fourth day.

The preserved meat all through was increased by a quarter of a pound.

Since May 22nd, 1 lb. of preserved meat was issued daily.

Since October the 16th, fresh bread was issued three days out of four, before that, it was served out two days out of three.

From the 6th of October the amount of gooseberries and rhubarb was increased from 2 to 6 ozs.

Eight ounces of Allsopp's ale was issued twice a week in lieu of the evening grog, from the 25th of October, 1875, to the 27th of January, 1876, and from the latter date to the 4th of April, once a week, and so onward.

None of the officers were placed on the sick list during the quarter, but some of them showed symptoms of suffering the effects of hard work. Their high spirit appeared to keep them up to a great extent.

My belief at present is that any ship's company of the most picked men, following us, who will have to live on the same food, pass the same unprecedentedly long time in darkness and artificial light, exposed to the same intense cold, who, almost to a man, would be required and employed in sledging, a great part of the work of which would be of an exceptional nature, must and would undergo such a diminution of physical power as would lead to the development of scurvy in the absence of any prophylactic.

THOMAS COLAN, M.D.,
Fleet-Surgeon.

Approved, G. S. NARES,
Captain.

SPECIAL MONTHLY RETURN OF H.M.S. "ALERT" BETWEEN
THE 1ST AND 31ST JULY, 1876.

Disease.	Cases remaining from last Return.	Added to List during Quarter.	Died.	Discharged to duty.	Remaining on List at end of Quarter.	Days' Sickness.
Scurvy	27	1	..	12	16	706
Diarrhœa .. ..	..	1	..	1	..	1
Totals	27	2	..	13	16	707

Number of all Ranks and Ratings on Board.			Movements of the Ship during the Quarter.		
Rank and Rating.	No. Borne.		Date sailed from.	Date arrived at.	Remarks.
Captain or Commander ..	2				
Lieutenants	4				
Sub-Lieutenants	2				
Chaplain	1				
Fleet Surgeon.. ..	1				
Surgeon	1				
Ice Quartermasters	3				
Assistant Paymaster	1				
Naturalist	1				
Seamen, Stewards, Boys, &c.	39				
Marines	6				
Engineers	2				
Stokers	4				
Esquimaux	1				
Total	68				
Average No. of all Classes for the period .. }	60				
			Winter Quarters. Floe Berg Beach. Latitude 82° 27' 1" N. Longitude 61° 22' W. July 31st, and proceeded to sea.		The weather was fine at times, but never very warm, and snow took place occasionally. The snow on the hills melted in great part, and rivulets and rivers formed. The average height of the Thermometer (Fahrenheit) was, for the month, + 40·884°.

REMARKS APPENDED TO SPECIAL MONTHLY REPORT OF H.M.S. "ALERT," FROM THE 1ST TO 31ST JULY, 1876.

No certificates for wounds or hurts, and no trusses were granted. The ship's company were five days on salt provisions; seventeen on preserved; and nine on fresh.

Lime juice was issued thirty-one days and soft bread twenty-four.

Twenty-seven cases of scurvy remained on the sick list from last return, and one case was added during the month. Of Commander Markham's party, numbering 14 (exclusive of two officers), who returned to the ship on the 13th and 14th of June, six were discharged to duty, as was one of Lieutenant Aldrich's party of seven (excluding the officer), who got back on the 25th of June. To these are to be added five cases which had been on the list previously—Total 12. This leaves 16 remaining on the 31st of July.

For some time there were several serious cases to deal with, chiefly those with hydro-thorax, but I am happy to be able to state that this and other complications were successfully met, and that all under treatment for scurvy at the end of the month were improving.

A most careful system of nursing was adopted, the men confined to bed always having assistance at hand, the nurses having written instructions how to act regarding putting bed pans under men, &c. Dr. Moss and myself watched the cases narrowly, so as to meet any complications that might arise. Several men were placed on the sick mess, and notwithstanding the large number, the meals were regularly given, as well as anything extra, between them. Fortunately I was enabled to give those on the sick mess 22 days' fresh meat, consisting of musk ox, ducks, hare, and geese. Potatoes were given every day, as were also pickles and carrots and cabbage frequently, fruits regularly, and the soft bread issued sufficed for nearly all meals. I had to draw largely on the medical comforts for apple jelly, oysters, milk, boiled fowl, extract of mutton, macaroni, arrow-root, refined sugar, port wine, and sherry, and on the ship's stores for beer. The diet was sometimes varied with bacon and haddocks. Recently caught trout were given twice.

The lime juice, beer, wine, and soup were given at stated times. Sorrel, when practicable, was procured from the shore and given, as were also small quantities of mustard and cress grown on board.

As the cases progressed towards recovery, many of them were given daily the citrate of iron and quinine, and one case seemed to be much benefited from taking cod liver oil. Some of the men discharged to duty were allowed half a pint daily of Allsopp's ale in lieu of rum. Faintness and looseness of the bowels soon disappeared, but effusion into

the lung tissue, pleural cavity, and sub-cutaneous and inter-muscular cellular tissue lasted a much longer time.

As the men got better, and the weather permitted, they were either hoisted on deck for the fresh air in a cot, or helped up by others, or managed to get there by themselves. They were carefully clothed, as the weather was never very warm, the temperature in the shade being sometimes below freezing point, and cloudy days frequent. Snow fell occasionally. As many of the men had to perform the calls of nature between decks, either in a bed-pan, or in the night stool, disinfection by means of carbolic acid was carried out, the utensils being kept as clean as circumstances would permit. I am persuaded that the dietetic system adopted proved of the utmost benefit to the sick, and were it not for rigidity of the hamstrings and hardness of the legs more cases would have returned to duty than did so.

The following are the names and principal symptoms of the men remaining on the sick list at the end of the month :—

Robert Symonds	..	Æt. 25, A.B.	..	..	..	Rigid hamstrings.
John Shirley	..	„ 33, Stoker-Mechanic	..	..	..	Discoloured knees and rigid hamstrings
Thomas Rawlings	..	„ 33,	„	..	..	Rigid hamstrings and hard legs.
Thomas Jolliffe	..	„ 35, Captain Maintop	..	..	..	Rigid hamstrings.
Thomas Simpson	..	„ 23, A.B.	..	..	..	Rigid hamstrings.
William Ferbrache	..	„ 23, A.B.	..	..	..	Rigid hamstrings.
Alfred R. Pearce	..	„ 27, A.B.	..	..	..	Rigid hamstrings and piles.
John Hawkins	..	„ 38, Cooper	..	..	..	Œdema of legs.
William Ellard	..	„ 27, R.M.L.I.	..	..	..	Sore gums. Rigid hamstrings.
Joseph Good	..	„ 32, Chief Boatswain's Mate	..	..	..	Slightly swollen legs.
James Doidge	..	„ 28, Captain Forecastle.	..	..	..	Sore gums, rigid hamstrings.
David Mitchell	..	„ 25, A.B.	..	..	..	Hard legs. Rigid hamstrings.
Henry Mann	..	„ 23, Shipwright	..	..	..	Debility, swollen gums, some rigidity of hamstrings.
Thomas Stubbs	..	„ 25, Stoker Mechanic	..	..	..	Debility from scurvy.
William Wood	..	„ 32, Colour Sergeant R.M.L.I.	..	..	..	Left leg swollen and slightly discoloured ; weak in small of back.
Thomas Stuckberry	..	„ 32, Captain Maintop	..	..	..	Lividity in left leg. Rigid hamstrings.

The last named man was placed on the sick list during the month. He had been two sledge journeys with Lieutenant Giffard beyond Cape Joseph Henry, and also with the relief party to near View Point. He had some symptoms of scurvy for some time before admission on the sick list, but did duty on board. One case of diarrhoea was entered in the person of Frederick, æt. about 28, Esquimaux, who had been away on a dog-sledge of three days to Cape Union and back. He remained but one day on the sick list. The general health of those not affected with scurvy was good, and would have been better doubtless if they had had more fresh meat ; still nine days of such were a great treat and benefit to men who had had none for over three months, and but 14 dinners of it for ten. Preserved meat was issued during the month, with bacon in lieu of salt meat every fourth day. Bread was continued as usual three days out of four. Allsopp's ale to the amount of half a pint was issued to each man once a-week.

THOMAS COLAN, M.D.,

Fleet Surgeon.

Approved, G. S. NARES,

Captain.

RETURN OF SICK AND WOUNDED OF H.M.S. "ALERT," FROM THE
1ST OF JULY TO THE 30TH OF SEPTEMBER, 1876.

Disease.	Cases remaining from last Return.	Added to List during Quarter.	Died.	Discharged to duty.	Remaining on List at end of Quarter.	Number of Days' Sickness.
Scurvy	27	1	..	28	..	904
Diarrhoea .. .. .	..	1	..	1	..	1
Colic and Constipation .. .. .	..	1	..	1	..	5
Frost-bite .. .. .	..	1	..	1	..	10
Totals	27	4	..	31	..	920

Number of all Ranks and Ratings on Board.		Movements of the Ship during the Quarter.		
Rank and Rating.	No. Borne.	Date Sailed from.	Date Arrived at.	Remarks.
Captain or Commander ..	2		Shift Rudder Bay, Aug. 8.	The weather was at times fine, but was in general cold. Snow fell occasionally, and rain a few times. There was not much wind. The average height of the Thermometer, Fahrenheit, was as follows:— July, 38°-84°. Aug., 33°-87°. Sept., 35°-62°. giving an average for the Quarter of 35°-62°.
Lieutenants	4		Lady Franklin Strait, Aug. 11.	
Sub-Lieutenants	2	Shift Rudder Bay, Aug. 10.	Rawlings Bay, Aug. 21.	
Chaplain	1	Lady Franklin Strait, Aug. 18.	Maury Bay, Aug. 23	
Fleet Surgeon	1	Rawlings Bay, Aug. 22.	Dobbin Bay, Aug. 27	
Surgeon	1	Maury Bay, Aug. 24	Allmann Bay, Sept. 3.	
Ice Quartermasters	3	Dobbin Bay, Sept. 3	Off Hayes Sound, Sept. 7.	
Assistant Paymaster	1	Allmann Bay, Sept. 6.	Off Cape Isabella, Sept. 9.	
Seamen, Stewards, Boys, &c.	39	Off Hayes Sound, Sept. 9.	Bardin Bay, Sept. 12	
Marines	6	Off Cape Isabella, Sept. 9.	Off Lively, Sept. 25.	
Engineers	2	Bardin Bay, Sept. 12	Egedesminde, Sept. 29.	
Stokers	4			
Esquimaux	1			
Naturalist	1			
Total]	68			
Average No. of all classes for the period	60			

REMARKS ACCOMPANYING THE NOSOLOGICAL RETURN OF
H.M.S. "ALERT," FOR MICHAELMAS QUARTER, 1876.

Cases (Special).

Name.	Quality.	Age.	Injury.	Date.
W. H. May ..	Lieutenant..	26,	Frost-bite, followed by amputation of part of left great toe ..	September 27.
James Self ..	A.B. ..	27,	Frost-bite, followed by amputation of right great toe ..	September 27.
Thomas Oakley..	G.M.A. ..	28,	Frost-bite, followed by amputation of part of right great toe ..	September 27.

The ship's company were 19 days on bacon, 14 on fresh, and 59 on preserved meat.

Lime juice was issued for 92 days.

Soft bread was issued for 65 days.

I am happy to be able to report that at the end of the quarter there was no person on the sick-list, and that during the period of this return but four admissions had occurred.

For seven weeks, viz., from August 1st to September 21st, there took place no entry whatever, and there were but two entries in two months. For a month before leaving the ice and for nearly a week after, there were no entries. At the commencement of Midsummer Quarter, 27 cases of scurvy were on the sick-list, remaining from the quarter before. This was the highest number reached at one time. But one case of scurvy was admitted this quarter. I deemed it advisable to make a special report for the month of July, as it involves the state and treatment of our heaviest number. For some time in July there were several serious cases to deal with, chiefly those with hydro-thorax, but all, by God's blessing, were successfully treated, and all the men affected and on the sick list were doing well at the end of the month. The tendency to faintness and diarrhœa had soon disappeared, but the effusion into the pleural cavity, the lung, and inter-muscular and cellular tissues, lasted a longer time. While the cases demanded it a most careful system of nursing was adopted, the nurses having written instructions how to act regarding putting bed-pans under the patients in bed, &c. Dr. Moss and myself watched the cases narrowly so as to meet any complications that might arise, such as diarrhœa and syncope. The sick mess previously organized was carried on, and a large number of sick men dieted from it. Although the pressure of work on my staff was heavy in consequence, yet the meals were regularly given, as well as anything extra required between them. Fortunately during July and August I was enabled to give the worst cases 45 days' fresh meat, consisting of musk ox, ducks, hares, and geese. Potatoes were given every day, as also pickles, cabbage frequently, and fruits according to circumstances. For breakfast and tea, and sometimes for dinner, I drew on the medical comforts for apple jelly, oysters, milk, boiled fowl, extract of mutton, maccaroni, arrow-root, refined sugar, port wine, sherry, and brandy, and on the ship's stores for ale. Recently caught salmon trout was given twice. Preserved meat was eaten when fresh could not be obtained. The diet was sometimes varied by bacon and Findon haddock. Some stunted sorrel when practicable was procured from the shore and given in small quantities. Some mustard and cress grown on board was much relished. Lime juice was given regularly at stated intervals, as were also the beer, wine, and extract of mutton (as soup).

Counter-irritant treatment was generally that adopted in the cases of effusion. As the men progressed towards recovery, many of them got the citrate of iron and quinine. Such increased the appetites of some, though but few required such stimulation, for on the whole, the sick men ate in a most hearty manner, and some better than the healthy men. Cod liver oil was given to two men, one of whom appeared to benefit by it rapidly. The weather throughout July was, on the whole, dull and cold. Snow fell at times and the temperature was more than once below freezing point. When the weather did permit, as the men got better, they were sent on deck, the bad cases being hoisted up in a cot and laid on beds. All the men were carefully clothed. The symptoms that lasted longest were rigidity of the hamstrings and hardness of the legs; but for these several felt well and capable of work. A good temperature was kept up in the steerage, and great care was taken to use disinfectants, which were rendered necessary from the functions of nature having to be performed on the spot. Twelve cases were discharged to duty in July, fourteen in August, and two in September early. The man placed on the sick list this quarter was Thomas Stuckberry, æt. 32, captain maintop, who had been two sledge journeys with Lieutenant Giffard to beyond Cape Joseph Henry, and with a relief party to near View Point. He had some symptoms of scurvy before admission on July 5th, and, on the whole, had swollen gums, discoloured legs, and rigid hamstrings. I am persuaded that the dietetic system adopted proved of the utmost benefit. Fresh food together with lime juice acted almost at once in a favourable direction, and men seldom got any relapse if fresh food could be given them.

Lime juice is invaluable as a preventive and cure for scurvy, but fresh meat ought I think to be accorded a high place for its usefulness in restoring scorbutic men to health.

Frederick, æt. about 28, Esquimaux, after a dog-sledge journey of three days was seized with diarrhœa, but was only one day on the sick list. Mr Crawford Conybeare, æt. 22, Sub-Lieutenant of the "Discovery" doing duty on board this ship, was 10 days on the sick list from inflammation of the tip of the left great toe caused by the irritation of portions of the nail the remainder of which had decayed after frost-bite. John Hollins, æt. 28, P.R.M.L.I., was five days on the sick list for colic, to which he is subject.

The general state of health of those unaffected with scurvy was good, and would doubtless have been better if they had had more fresh meat. During the quarter all had 14 days' fresh meat (in 13 months the ship's company had but 28 days' fresh meat), 12 of which were of musk ox, and two of ducks; previous to this they had almost none for three months, and but 14 dinners for ten; some seal flesh (of the *Phoca fatida*) was eaten

and generally liked, some cod fish and corned salmon were very welcome at Lievely, as also cod at Egedesminde, where we got in addition 26½ lbs. of reindeer (some of which went to the "Discovery"). A firkin of butter was given by the officers to the men, which was much appreciated. Some American hams left by the "Polaris" were distributed and liked. Bacon in lieu of salt or corned pork was issued every fourth day, and the men had the option of taking up pork every eighth day in place of preserved meat. Half a pint of Allsopp's ale was given daily to several men on the sick list and to a few off it for a time. To the general ship's company half a pint of ale was given once a week up to August 26th, from the 10th to 28th of September every second day, and from the 28th to the 30th every day. A double quantity of potatoes was given through the quarter. An extra allowance of lime juice was issued from the 1st to the 6th of July, and to those who wished it from the 14th to the 30th of September. The general health of the officers was good. On the 12th of August 10 men on the sick list, and four not very strong off it, were sent to the "Discovery," it being deemed best to let them remain in her while this ship proceeded to Polaris Bay to fetch back Lieutenant Beaumont's party if there, a proceeding obviated by their return, so our men came back, some on the 15th and the rest on the 18th of the month. After a most difficult, trying, and tedious passage we got clear of the ice on the 9th of September. As we proceeded South we encountered head winds and foggy and damp weather; some of the men, though well clothed, suffered from rheumatic pains, and many will probably contract colds on the voyage to England. This ship coaled at Lievely, and the "Discovery" at Egedesminde.

Three pension certificates were issued to the three persons named in the table who got frost-bitten last year and got well this.

THOMAS COLAN, M.D.,
Fleet-Surgeon.

Approved, G. S. NARES,
Captain.

RETURN OF SICK AND WOUNDED OF H.M.S. "ALERT," FROM THE
1ST OF OCTOBER TO THE 2ND OF NOVEMBER, 1876.

Disease.	Cases remaining from last return.	Added to List during Quarter.	Died.	Discharged to Duty.	Remaining on List at end of Quarter.	Number of Days' Sickness.
Catarrh	7	..	6	1	40
Bronchitis	1	..	1	..	10
Dyspepsia	2	..	2	..	21
Wounds	2	..	2	..	21
Nervous shock from a fall..	..	1	..	1	..	3
Totals	13	..	12	1	95

Number of all Ranks and Ratings on Board.			Movements of the Ship during the Quarter.		
Rank and Rating.	No. Borne.		Date Sailed from.	Date Arrived at.	Remarks.
Captain or Commander ..	2				
Lieutenants	4				
Sub-Lieutenants	1				
Chaplain	1		Egedesminde, Oct. 2	Valentia Harbour, Ireland, Oct. 27.	The weather during this period of the return has been bad, gales were frequent, and rain fell often. The average height of the thermometer was about 44·5°.
Fleet Surgeon	1				
Surgeon	1				
Ice Quartermasters	3		Valentia Harbour, Oct. 28.	Queenstown Harbour, Oct. 29.	
Assistant Paymaster	1				
Seamen, Stewards, Boys, &c.	33				
Marines	6		Queenstown Harbour, Oct. 30.	Portsmouth, Nov. 2	
Engineers	2				
Stokers	4				
Naturalist	1				
Total	60				
Average No. of all Classes for the period	60				

REMARKS ACCOMPANYING THE NOSOLOGICAL RETURN OF H.M.S.
"ALERT," FROM 1ST OCTOBER TO 2ND NOVEMBER, 1876.

The crew were on bacon six days ; on preserved provisions 20 ; and on fresh six.
Soft bread was issued 32 days.

During the period of this return 13 cases were placed on the sick list. The change to a damp atmosphere, together with exposure to most inclement weather on the passage home, induced colds and rheumatic pains among some of the men. Seven cases of catarrh and one of bronchitis occurred. Of the former one remains on the sick list owing to a fall down the lower deck's foremost ladder, Arthur T. Norris, æt. 24, carpenter's crew, sustained a shock to the nervous system. He was however discharged to duty in three days. Two cases of dyspepsia were treated and discharged. Two cases of wounds from accident occurred during heavy weather. Lime juice was issued once a day to all for 30 days, and twice a day to those who wished for it, for 27 days. Beer was issued for 18 days. Some of the medical comforts were distributed amongst the ship's company. The fresh provisions procured at Valentia were most welcome and beneficial. Since leaving that place fresh beef and vegetables have been issued daily.

THOMAS COLAN, M.D.,
Fleet-Surgeon.

RETURN OF SICK AND WOUNDED OF H.M.S. "DISCOVERY," FROM
1ST JULY TO 30TH SEPTEMBER, 1875.

Disease.	Cases remaining from last Quarter.	Added to List during Michaelmas.	Died.	Discharged to Duty.	Remaining on List at end of Quarter.	Number of Days' Sickness.
Rheumatism	1	..	1	..	2
Catarrh	1	..	1	..	2
Bronchitis	1	..	1	..	13
Dyspepsia	1	..	1	..	2
Diarrhœa	1	..	1	..	1
Colic and Constipation	1	..	1	..	2
Phlegmon and Abscess	2	..	2	..	8
Exhaustion	1	..	1	..	2
Wounds	2	..	2	..	19
Sprains	2	..	2	..	10
Contusions	2	..	2	..	10
Totals	15	..	15	..	71

Number of all Ranks and Ratings on Board.				Movements of the Ship during the Quarter.			
Rank and Rating.		No. Borne.	Date Sailed from.	Date Arrived at.	Remarks.		
					Barometer.		
Captain or Commander ..		1			Maximum, 30·72.		
Lieutenants		4			(Proven, July 20.)		
Sub-Lieutenants		1			Minimum, 29·30.		
Chaplain		1	Disco Island, West		Thermometer.		
Staff-Surgeon		1	Coast of Green-		Maximum, 62°.		
Surgeon		1	land, July 15	Retenbenk, July 16	(Disco Island, July 14.)		
Ice Quartermasters		3	Retenbenk, July 17	Proven, July 19	Minimum, 2·5°.		
Naturalist		1	Proven, July 21	Upernivik, July 22	(Winter Quarters, Sept. 22.)		
Assistant Paymaster		1	Upernivik, July 22	Cape York, July 25	July.	Aug.	Sept.
Seamen, Stewards, Boys, &c.		31	Cape York, July 26	Foulke Bay, July 28			
Marines		8	Foulke Bay, July 29	Cape Sabine, July 30		Rain.	
Engineers		2	Cape Sabine, Aug. 3	Winter Quarters,	6 days.	1 day.	—
Stokers		4		Discovery Bay,		Fog.	
Esquimaux		1		Lat. 81° 44' N.,	8 days.	4 days.	5 days.
				Long. 65° 3' W.		Snow.	
Total		60			1 day.	8 days.	10 days.
Average No. of all Classes for the period ..		55·7			Greater part of the month fine clear weather, very little wind.		

REMARKS ACCOMPANYING NOSOLOGICAL RETURN OF H.M.S.
 "DISCOVERY," FOR QUARTER ENDING 30TH SEPTEMBER, 1875.

Cases remaining from last Return, none ; added during quarter, 15.

General Diseases, Section B.—Rheumatism : Mr. Cartmel, 37, Engineer, complained of pains in the hips and loins, September 12th. No constitutional disturbance. A mixture containing nitric æther and acetate of ammonia enabled him to resume his duties on the 13th.

Diseases of the Respiratory System.—Catarrh : Captain Stephenson, 33, placed under treatment August 30th, complaining of coryza, malaise, and slight sore throat ; pulse 80 ; temperature at night, 99°. Diaphoretics were administered, and a gargle of alum used. He was convalescent September 2nd.

Diseases of the Digestive System.—Dyspepsia : Mr. Fulford, 24, Lieutenant, under treatment August 23rd, suffering from headache and general derangement of the digestive organs. A purgative, followed by a mixture containing mineral acids in a bitter tonic, rendered him fit for duty August 25th. Diarrhœa : one case, that of a Petty Officer, who stated that it had existed for some days ; placed on the Sick List August 1st, and sedatives and astringents administered. He was discharged to duty the next day. Colic : one case, an A.B., placed under treatment July 19th, complaining of paroxysmal pain in the abdomen, nausea, and vomiting. Castor-oil with tr. opii. 15, afforded permanent relief.

Diseases of the Cellular Tissue.—Phlegmon and Abscess : Mr. C. H. Hart, 27, Naturalist, placed on the Sick List July 28, suffering from three or four phlegmons on the thighs, which yielded to local applications, and he was discharged to duty August 4th. Likewise an A.B. with a similar affection of the left middle finger. Under treatment for four days.

Diseases unclassified.—Exhaustion : an A.B., who accompanied the Captain and Naturalist on a shooting excursion in Hayes Sound, August 4th. The distance travelled was not more than five or six miles, but he was so completely exhausted that he had to be carried in a hammock or by men for the last mile or more. No organic disease. He was fit for duty on board the next day.

Wounds and Injuries.—Gnat-bites : a Carpenter, severely bitten about the face and eyes by gnats at Retenbenk, so as to be unable to open his eyelids. Incised wound of knuckle of left index finger ; under treatment from the 4th August to the 22nd. He was the Captain's servant. Sprain of the left ankle, of a slight nature. The patient was an A.B., who slipped on the upper deck ; under treatment three days. Sprain : Mr. L. A. Beaumont, 28, Lieutenant, in jumping from one piece of ice to another sprained his left ankle ; under treatment from 16th to 23rd August. Contusion : this same officer, on July 20th, sustained a contusion over the eleventh and twelfth ribs by falling on a sextant-box when stepping out of a boat with the box under his arm. He rested until the 23rd, when he was discharged to duty at his own request. A chief Boatswain's Mate struck the right knee against a hawser. Treatment consisted in turpentine liniment and a bandage ; under treatment from August the 1st to the 8th.

Issue of salt provisions, 42 days ; fresh, 15 days ; preserved, 35 days.

BELGRAVE NINNIS, M.D.,

Staff-Surgeon.

RETURN OF SICK AND WOUNDED OF H.M.S. "DISCOVERY," FROM
 THE 1ST OF OCTOBER TO 31ST OF DECEMBER, 1875.

Disease.	Cases remaining from last Quarter.	Added to List during Christmas Quarter.	Died.	Discharged to Duty.	Remaining on List at end of Quarter.	Number of Days' Sickness.
Pleurodynia	1	..	1	..	5
Catarrh	5	..	5	..	33
Dyspepsia	1	..	1	..	7
Colic and Constipation	2	..	2	..	15
Hæmorrhoids	1	..	..	1	25
Phlegmon and Abscess	2	..	2	..	13
Frost-bite	2	..	2	..	28
Parulis	1	..	1	..	5
Wounds	1	..	1	..	2
Sprains	3	..	2	1	19
Contusions	3	..	3	..	19
Totals	22	..	20	2	171

Number of all ranks and Ratings on Board.			Movements of the Ship during the Quarter.			
Rank and Rating.	No. Borne.	Date Sailed on.	Date Arrived at.	Remarks.		
Captain or Commander ..	1	Frozen in Discovery Bay. Latitude 81° 44' N. Longitude 65° 3' W.		Thermometer.		
Lieutenants	3					
Sub-Lieutenants	1					
Chaplain	1					
Staff-Surgeon	1					
Surgeon	1					
Ice Quartermasters	3					
Naturalist	1					
Assistant Paymaster ..	1					
Seamen, Stewards, Boys, &c.	25					
Marines	7					
Engineers	2					
Stokers.. ..	4					
Esquimaux	1					
Total	52					
Average No. of all Classes for the period	52					
				Barometer.		
					Max.	Min.
				October	36·48	29·46
				November	30·92	29·78
				December	30·60	29·02

REMARKS ACCOMPANYING NOSOLOGICAL RETURN OF H.M.S.
“DISCOVERY,” FOR QUARTER ENDING 31ST DECEMBER, 1875.

Fresh provisions have been issued to the crew 23 days; preserved meat and vegetables, 34 days; and salt beef and pork, 35 days.

The supply of fresh meat has been derived from musk oxen, 32 of which have been shot since the end of August, yielding about 6,000 lbs. of good beef.

The autumn sledging, which extended from October 4th to 15th, and in which about 20 men and officers were engaged, has resulted in two superficial frost-bites. Thomas Simmonds, 30, captain of the forecastle, and Daniel Girard, 26, A.B., both engaged in packing a sledge, during which operation their feet became very cold; but not experiencing any pain they did not mention the fact until 5 or 6 hours afterwards, when on examination the left great toe in each case was found to be frost-bitten. They were immediately put on a sledge, and dragged back to the ship, the parts being packed in wool in the meantime. The result was the loss of a small portion of integument from the under surface of the tip, the cases being similar throughout.

The health of the crew was very good, the periodical examination bringing to light scarcely a “foul tongue”; a few catarrhs, sprains and contusions making half of the total number under treatment.

The sun left us on the 16th of October, and the temperature is falling rapidly. The ship is housed in, and the deck covered with snow, and every precaution being taken to warm and ventilate the ship between decks, which I trust will prove successful. The working hands are employed on the ice during working hours, and the idlers are kept in the open air for two hours (at least) daily. A skating rink has been made, and is constantly in use by those who are the fortunate possessors of skates. In addition we have an ice theatre, warmed by a stove when plays are being performed, and an ice smithy, where the forge is set up, and where the artificers work. Thus occupation and amusement are being provided, and we hope to pass the winter in health, strength, and contentment.

BELGRAVE NINNIS, M.D.,
Staff-Surgeon.

RETURN OF SICK AND WOUNDED OF H.M.S. "DISCOVERY," FROM
1ST JANUARY TO 31ST MARCH, 1876.

Disease.	Cases remaining from last Return.	Added to List during last Quarter.	Died.	Discharged to duty.	Remaining on List at end of Quarter.	Number of Days' Sickness.
Rheumatism	2	..	2	..	7
Scurvy	1	..	..	1	90
Neuralgia (face)	3	..	3	..	12
Pleurodynia	2	..	2	..	37
Varicose Veins	1	..	1	..	3
Catarrh	3	..	3	..	21
Diarrhœa	2	..	2	..	26
Colic and Constipation	2	..	2	..	37
Hæmorrhoids	1	1	..	2	..	46
Phlegmon and Abscess	1	..	1	..	27
Frost-bite	1	..	1	..	3
Sprains	1	1	..	2	..	18
Contusions	2	..	2	..	9
Burns	1	..	1	..	15
Totals	2	23	..	24	1	351

Number of all Ranks and Ratings on Board.			Movements of the Ship during the Quarter.																														
Rank and Rating.		No. Borne.	Date Sailed from.	Date Arrived at.	Remarks.																												
Captain or Commander	..	1	Frozen in Discovery Bay. Latitude 81° 44' N. Longitude 65° 3' W.		<div>Thermometer.</div> <table><tr><td></td><td>Max.</td><td>Min.</td><td>Med.</td></tr><tr><td>Jan.</td><td>-13°</td><td>-63°</td><td>-40·6°</td></tr><tr><td>Feb.</td><td>+2°</td><td>-58°</td><td>-35·2°</td></tr><tr><td>March</td><td>-8°</td><td>-70·75°</td><td>-37·5°</td></tr></table> <div>Barometer.</div> <table><tr><td></td><td>Max.</td><td>Min.</td></tr><tr><td>January</td><td>30·29</td><td>29·10</td></tr><tr><td>February</td><td>30·53</td><td>29·17</td></tr><tr><td>March</td><td>30·62</td><td>29·64</td></tr></table>		Max.	Min.	Med.	Jan.	-13°	-63°	-40·6°	Feb.	+2°	-58°	-35·2°	March	-8°	-70·75°	-37·5°		Max.	Min.	January	30·29	29·10	February	30·53	29·17	March	30·62	29·64
	Max.	Min.				Med.																											
Jan.	-13°	-63°				-40·6°																											
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March	-8°	-70·75°				-37·5°																											
	Max.	Min.																															
January	30·29	29·10																															
February	30·53	29·17																															
March	30·62	29·64																															
Lieutenants	..	4																															
Sub-Lieutenants	..	2																															
Chaplain	..	1																															
Staff-Surgeon	..	1																															
Surgeon	..	1																															
Ice Quartermasters	..	3																															
Assistant Paymaster	..	1																															
Naturalist	..	1																															
Seamen, Stewards, Boys, &c.	27																																
Marines	..	7																															
Engineers	..	2																															
Stokers	..	4																															
Esquimaux	..	1																															
Totals	..	56																															
Average No. of all Classes for the period	..	52																															

REMARKS ACCOMPANYING THE NOSOLOGICAL RETURN OF H.M.S.
"DISCOVERY," FOR LADY-DAY QUARTER, 1876.

Twenty-five patients have been under treatment during this quarter, all of whom, with one exception, have been discharged to duty cured.

Scurvy.—A very severe case of this disease has occurred. The patient, James Shepherd, æt. 34, cooper, a fine-looking man, but one who has been accustomed to drinking to excess, dislikes preserved meat and vegetables, and is very fastidious about the flavour of musk-ox meat. Complained, January 1st, of pains in left knee and groin, which he referred to a strain about a week previously. There was a small red patch on the inside of the knee where it had been resting on its fellow. The gums appeared somewhat inflamed; but as he acknowledged to never cleaning his teeth this was thus easily accounted for. He was, however, immediately put on an antiscorbutic regimen; but the disease rapidly developed itself, gums became spongy, ulcerated, and bleeding

on slight provocation ; knees swollen and stiff, discoloration in patches on both legs, followed lately by pains in the thighs, foetid breath, and dyspepsia. His present condition is that of great depression, inability to eat any but the softest food, crippled by contraction of the hamstring muscles, occasional epistaxis and dyspnoea. No abnormal stethoscopic signs. Everything has been done to arrest the progress of the disease, and the patient is now certainly gaining strength, but the extreme cold and absence of sunlight have been very much against him. The mean temperatures for January, February, and March have been : $-40\cdot6^{\circ}$; $-35\cdot2^{\circ}$; and $-37\cdot5^{\circ}$ respectively, the sun appearing above the horizon for a few minutes on February 29th.

Frost-bite.—George Leggett : One case, that of the ship's cook, who took a walk on the ice when wearing ordinary leather boots, the result being superficial frost-bite of the end of each great toe.

Frequent examination of the crew shows them to be in excellent health, due, I have no doubt, to the frequent issue of fresh meat. We have been on salt provisions 32 days during this quarter ; preserved provisions, 29 days ; and musk-ox beef, 30 days.

BELGRAVE NINNIS, M.D.,
Staff-Surgeon.

RETURN OF SICK AND WOUNDED OF H.M.S. "DISCOVERY," FROM
1ST APRIL TO 30TH JUNE, 1876.

Disease.	Cases remaining from last Return.	Added to List during Midsummer Quarter.	Died.	Discharged to Duty.	Remaining on List at end of Quarter.	Number of Days' Sickness.
Rheumatism	1	1	..	1	..	3
Scurvy	1	15	2	6	8	575
Snow Blind .. ..	..	3	..	3	..	11
Frost-bite .. ..	..	1	..	1	..	15
Sprains .. ..	..	1	..	1	..	3
Contusions .. ..	..	2	..	2	..	19
Totals	1	23	2	14	8	626

Number of all Ranks and Ratings on Board.		Movements of the Ship during the Quarter.		
Rank and Rating.	No. Borne.	Date Sailed from.	Dated Arrived at.	Remarks.
Captain or Commander	1	Discovery Bay, Latitude $81^{\circ} 44'$ N. Longitude $65^{\circ} 3'$ W.		Thermometer. <div>Max. Min. Med.</div> <div>April $+13^{\circ}$ -42° ..</div> <div>May $+33\cdot6^{\circ}$ $-20\cdot5^{\circ}$..</div> <div>June $+41^{\circ}$ $+16\cdot5^{\circ}$..</div> Barometer. <div>Max. Min.</div> <div>April 30·75 29·78</div> <div>May 30·43 29·56</div> <div>June 30·08 29·41</div>
Lieutenants	4			
Sub-Lieutenants	1			
Chaplain	1			
Staff-Surgeon	1			
Surgeon	1			
Ice Quartermasters	3			
Assistant Paymaster	1			
Naturalist	1			
Seamen, Stewards, Boys, &c.	31			
Marines	8			
Engineers	2			
Stokers	4			
Esquimaux	1			
Total	60			
Average No. of all Classes for the period	52			

REMARKS ACCOMPANYING A NOSOLOGICAL RETURN OF THE SICK
AND WOUNDED OF H.M.S. "DISCOVERY" BETWEEN THE 1st APRIL,
1875, AND 30th JUNE, 1876, EMPLOYED ON ARCTIC SERVICE.

Salt provisions have been issued on thirty-four days during this quarter, preserved meat fifty-three days, and fresh musk-ox beef, hares or waterfowl four days.

The spring sledging season commenced early in April, since which time all hands, with four exceptions, have been away for long or short journeys. The health of the various parties on the long journeys has been very bad, so much so as to cause their complete disorganization. Out of twenty-four patients under treatment during the quarter twenty have been men on sledge journeys.

Scurvy.—Sixteen cases under treatment, fifteen of which are fresh ones; one remaining from last Return. Of this number two have died, six have been discharged to duty, and eight are still under treatment.

Deaths.—James J. Hand, 28, A.B. This patient was not under medical treatment at any time during his illness. He formed one of a party of seven men and an officer who were lent from the "Discovery," and who passed the whole winter (between August 26th, 1875, and April, 1876) on board the "Alert." When the spring sledging began he was attached to the North Greenland Division, starting early in April. It appears from the sledging journal of the officer in command of this party, that early in May he complained of stiffness in his legs, that he was unable to walk on the 20th, and henceforth was carried on the sledge, and he died on the 3rd of June. The symptoms appear to have been—first, stiffness of legs, with patches of discoloration, tender gums, cough, dyspnoea, vertigo, rigors, pains through the chest, despondency, frequent groaning, falling out of the teeth, delirium, alternate rigors and profuse diaphoresis, urgent dyspnoea, and death.

William Paul, 27, A.B. This patient was entered at Disco from the "Valorous," remained on board the "Discovery" all the winter (not being one of the party which went to the "Alert"), and formed one of the North Greenland Division. The particulars of his illness are likewise taken from the sledging journal of the officer in command of the party, as he was not seen by a medical officer until four days before his death, which took place 29th of June. His first complaint was made on the 17th of May; pain and stiffness of legs, which extended to the thighs; he soon became unable to walk or stand, and was carried on the sledge from 3rd June. On the 25th June he was seen by Dr. Coppinger, who went out with a party to search for the party of which he was one, and which was many days over due at Polaris Bay. Dr. Coppinger found him extremely weak, scarcely able to move, covered with ecchymosed patches from the feet to the thighs, and all the characteristic signs of advanced scurvy. For the next twenty-four hours he appeared slightly better; but it was evident nothing could be done until the patient could be freed from the fatigue of travelling on a sledge, and comfortably housed. A forced march was made, and the depôt at Polaris Bay reached about 1 a.m. on 29th June, but it was evident he could not long survive. Dyspnoea increased, respirations became more frequent, pulse quicker and weaker, until 5.15 p.m., when he died, paroxysms of dyspnoea succeeding each other every few minutes for nearly an hour previously.

Cases discharged to duty.—1st, James Shepherd, 34, cooper. This patient was remaining from last quarter. His recovery was more rapid, as the rising temperature and the sunlight permitted his passing more time in the open air, and enabled me to raise a supply of mustard and cress, an account of which will be found in the Return for next quarter. He was discharged to duty on deck on 26th of June. 2ndly, Frank Chatell, 31, captain of fore-castle. 3rd, Michael O'Regan, 25, A.B. 4th, Jeremiah Rourke, 37, leading stoker. 5th, James Cooper, 26, 2nd captain maintop, and 6th, David Taws, 44, ice-quartermaster. All employed sledging from the beginning of April until the middle of June. All scurvy stricken towards the end of May, and all unfit for duty until late in June.

Cases Remaining under Treatment.—1st, Alfred Hindle, 25, A.B., convalescent but weak; 2nd, William Jenkins, 32, carpenter's mate, unable to rise from bed, very desponding, first ill 8th of May, carried on sledge from the 16th of June; 3rd, Peter Craig, 25, A.B., bedridden, unable to rise without assistance, first ill May 16th, carried on the sledge June 23rd; 4th, Wilson Dobing, 28, gunner R.M.A.—a very acute attack. He has now very considerable discoloration and œdema of the left leg, is confined to bed, very much debilitated. First taken ill 21st of May, carried on the sledge 23rd of June. 5th, George Bryant, 28, captain maintop. The most severe case

which has recovered. He is now very weak and his legs stiff, but he can walk with the assistance of a stick, and bids fair to make a rapid convalescence. 6th, Alexander Gray, 40, ice-quartermaster; he can walk with assistance, his left leg is much discoloured, very stiff and very weak. 7th, Frank Jones, 29, stoker; scarcely yet able to walk even with assistance, both his legs are much discoloured, very stiff, weak, and œdematous.

All these men commenced sledging in the first week in April. In less than a month Jenkins and Bryant showed unmistakable signs of scurvy. Craig, Dobing, and Hindle followed in ten days or a fortnight. Gray and Jones not until a month later, viz., towards the end of June and within a few days of the arrival of the party at the dépôt camp in Polaris Bay, thereby escaping the misery of struggling through deep snow when scarcely able to walk, as those who were first attacked were obliged to do. A detailed account of all these cases will be found in my Journal for 1876. Mr. Lewis A. Beaumont, 29, Lieutenant R.N. This officer, who was in command of the North Greenland Sledge Division, started with his men on the 6th of April. The nature of the work was very trying on account of the deep snow or heavy hummocks of ice through which a road had to be cut, and as his men became ill more work was necessarily thrown upon him and the remaining strong ones. On the 23rd of June he experienced stiffness of the knee-joints and rigidity of the hamstring muscles, stiffness of the muscles of the back and increasing weakness, gums sore. He was seen on the 25th by Dr. Coppinger, when in addition it was found that he had an eruption of purple spots on his legs, and an ulcerated patch on the inside of the left upper molar. The party being now comfortably encamped at Polaris Bay, he is convalescent but weak, stiffness nearly gone, gums resuming their normal appearance, and spots rapidly fading.

Treatment in all these cases has been the same. Fresh seal meat, game, lime juice, preserved fruit, wine, sorrel, of which a supply is to be obtained in various localities, besides the mustard and cress grown by myself. But these could only be administered after the return of the sledges, whereas the worst cases, including the deaths, were those who, being attacked early in the journey, had to sustain the fatigue of marching, and the cold and exposure inseparable from sledge travelling.

Causes.—The case of Shepherd, who was attacked in January, was evidently caused by the absence of light, fresh meat, and vegetables; and the cold, impure air, and moisture incidental to an arctic winter, acting upon a constitution debilitated by indulgence in excessive drinking, added to his wilful neglect of the sanitary arrangements, and surreptitiously abstaining from the fresh beef, preserved meat, and vegetables whenever he found the opportunity.

As regards the remaining fifteen cases, they have all occurred in men on sledge journey, with whom, in addition to the usual incitants to scurvy, viz., absence of light, fresh meat, and vegetables, and the presence of cold, impure air, and moisture, the excessive fatigue consequent upon dragging a heavy sledge through deep soft snow, or having to smooth a road through heavy ice hummocks, monotonous and depressing nature of the work, sameness of diet, total absence of fresh food (excepting pemmican) and the necessary exposure to cold and wet, have in my opinion been quite sufficient to account for the present outbreak.

The reason why so many men have been laid low by this disease in the present expedition, compared to former ones, must be looked for in the circumstances that

1st. The temperature during the winter has been lower than on any former occasion, viz., -70.75° to -72.70° .

2nd. The difficulties in the sledging were undoubtedly far more numerous, and the fatigue incomparably greater.

3rd. In all former expeditions abundance of game has always been procurable by the sledge parties; whereas on the present occasion there has not been sufficient seen by any one party to constitute a single day's ration.

The subject of scurvy will be found more fully treated of in the "Remarks" in my journal for 1876.

Before starting on a sledging journey each officer and man was examined by me in reference to their fitness for the undertaking.

BELGRAVE NINNIS, M.D.,
Staff-Surgeon.

RETURN OF SICK AND WOUNDED OF H.M.S. "DISCOVERY," FROM
1ST JULY TO 30TH SEPTEMBER, 1876.

Disease.	Cases remaining from last Return.	Added to List during Michaelmas Quarter.	Died.	Discharged to duty.	Remaining on List at end of Quarter.	Number of Days' Sickness.
Rheumatism	2	..	2	..	10
Scurvy	8	3	..	11	..	295
Neuralgia	2	..	..	2	38
Dyspepsia	1	..	1	..	2
Diarrhoea	1	..	1	..	26
Colic and Constipation	1	..	1	..	3
Phlegmon and Abscess	1	..	1	..	13
Syncope	1	..	1	..	6
Sprains	2	..	2	..	15
Totals	8	14	..	20	2	408

Number of all Ranks and Ratings on Board.		Movements of the Ship during the Quarter.		
Rank and Rating.	No. Borne.	Date sailed from.	Date arrived at.	Remarks.
Captain or Commander ..	1	Discovery Bay, Lat. 81° 44' N. Long. 65° 3' W. August 20.	Lievely Island, Disco, Sept. 25.	Large quantity of ice in Smith Sound, after pass- ing the entrance. Strong head wind, with fluctu- ating barometer.
Lieutenants	4			
Sub-Lieutenant	1			
Chaplain	1			
Staff Surgeon	1			
Surgeon	1			
Ice Quartermasters	3			
Assistant Paymaster	1			
Naturalist	1			
Seamen, Stewards, Boys, &c.	29			
Marines	8	Disco, Sept. 28.	Egedesminde, September 28.	Little or no ice (excepting bergs) in Melville Bay.
Engineers	2			
Stokers	4			
Esquimaux	1			
Total	58			
Average No. of all Classes for the period	58			

REMARKS ACCOMPANYING THE NOSOLOGICAL RETURN OF H.M.S.
"DISCOVERY," FOR QUARTER ENDING 30TH SEPTEMBER, 1876.

Preserved meat has been issued to the crew 21 days; salt beef or pork, 7 days; and fresh musk-ox meat, hares, or geese, 2 days.

Mustard and Cress.—In February I sowed some mustard and cress seed in a box, which I kept in the warmth below, but it was not until 13th of May that the product was so far advanced as to afford sufficient for a meal for my scorbutic patient. In the course of the next fortnight my box yielded six meals, and as the sun was now gaining power I enclosed a space on shore, 16 feet by 3 feet, and covered it in with the spare glass belonging to the engine-room skylight. This was finished and the first seeds sown on 29th of May, and an uninterrupted supply furnished from 21st of June until the 14th of August inclusive, not only to the sick, but on eleven occasions to all the crew. Had we continued in our winter quarters I have no doubt of having been able to keep up the supply until late in October.

Scurvy.—Three more cases of this disease have been under treatment during this quarter. They are not fresh ones, but cases of relapse, the men having had to undergo a

sledge journey as soon as their strength permitted it. Michael O'Regan, 25, A.B., and Frank Chatell, 31, captain of fore-castle, both returned from Polaris Bay on the 14th of July, to acquaint us with the state of the remainder of the parties in North Greenland, and Frank Jones, 29, stoker, who came over August 4th. All these men had been discharged to duty in Polaris Bay cured, the two former on the 29th June, and the latter on the 29th July. The journey is about 35 miles, and occupied in each case five days, but although the men were quite well before starting, on arrival on board they exhibited well marked signs of scurvy, but quickly recovered, we having plenty of fresh meat on board, and my garden producing ample mustard and cress. In a week they were all at duty.

Neuralgia.—Two cases. Mr. Reginald B. Fulford, 26, Lieutenant, placed under treatment on the 9th September, suffering from neuralgia of the face of a periodical nature. Large doses of quinine administered an hour before the anticipated period have destroyed the nature of the attacks, but he still suffers at times. I hope he will be at duty in a few days. This officer was invalided in 1874 from the Mediterranean for rheumatism after the station fever. William Ward, 31, armourer, placed on the Sick List on the 13th September, suffering from very severe pain in the left side of the chest, occasionally causing great dyspnoea. No constitutional disturbance. Turpentine stupes never fail to give immediate ease, but the pain recurs. He is much better. Quinine and nourishing food appear to be indicated. Neither of these patients have at any time shown symptoms of scurvy.

BELGRAVE NINNIS, M.D.,

Staff-Surgeon.

APPENDIX No. 34.

ABSTRACT OF AGES OF MEN IN EXPEDITIONS 1851-52, 1852-54 (AS FAR AS INFORMATION WAS SUPPLIED TO THE COMMITTEE).

Ship.	Years of Expedition.	Total Number.	Under 20.	Between 20 and 25.	Between 25 and 30.	Between 30 and 35.	Between 35 and 40.	Between 40 and 45.	Remarks.
Assistance ..	1850-51 ..	71	Nil	18	24	16	7	6*	*1 over 47, 2 over 50
Resolute ..	1850-51 ..	73	Nil	13	30	16	8	6	
Assistance ..	1852-54 ..	57	Nil	5	25	17	10	..	
Resolute ..	1852-54 ..	57	Nil	12	21	16	6	2	
North Star ..	1852-54 ..	54	Nil	8	19	12	8	7*	*1 over 46
(Crew partly changed)									
Total ..	..	312	..	56	119	77	39	21	

ABSTRACT OF AGES 1875-76.

Alert ..	1875-76 ..	49 and 1 Esquimaux	Nil	13	18	15	3	..	Esquimaux, Age not known
Discovery ..	1875-76 ..	47 including 1 Esquimaux	Nil	13	18	10	3	3*	*1 over 47
Total ..	..	97	..	26	36	25	6	3	

ALPHABETICAL LIST OF HEADINGS OF INDEX AND ANALYSIS.

*The names marked with * will be found in the Analysis of Evidence.*

- Abstainers.
 Acclimatisation.
 Acids.
 Air.
 *Aldrich, P.
 "Alert," H.M.S.
 Analysis.
 Appetite.
 Arctic Committee.
 Arctic Exploration.
 *Armstrong, Sir A.
 "Assistance," H.M.S.
 Austin, Sir H.
 Ayles, A.
 *Barnes, R.
 *Bayley, R.
 *Beaumont, L. A.
 Bedding and berthing.
 Beer.
 Belcher, Sir E.
 Benguella.
 Berrie, J.
 Blackwell, T.
 Bryant, G.
 Burroughs, G.
 *Busk, G.
 *Buzzard, T.
 Budd, Dr.
 *Cameron, V. L.
 Cane, J.
 Chalkley, T.
 Chatell, F.
 Christison, Sir R.
 Clothing.
 *Colan, T.
 Cooks.
 Cooper, J.
 *Coppinger, R. W.
 Craig, P.
 Cranberries.
 Darkness.
 *De Chaumont.
 Dépôts.
 Deuchars, D.
 *Dickson, W.
 Diet.
 Subheads—1. General.
 2. On board, in recent expedition.
 3. On board, in other expeditions.
 4. Of officers.
 5. Sledging and travelling.
 Discipline.
 "Discovery," H.M.S.
 Dobing, W.
 Doidge, J.
 Dominique, V.
 Drake, T.
 *Ede, C.
 *Egerton, G. L.
 Eggs.
 Elephantiasis.
 Ellard, W.
 *Emmerson, G.
 Equipment.
 Subheads—1. Ships.
 2. Sledges.
 Esquimaux.
 Exercise and sledge training.
 Subheads—1. General.
 2. Recent expedition.
 3. Former expeditions.
 Feilden, H. W.
 Foulke, Port.
 Francombe, R.
 Franklin, Sir J.
 Franz Joseph Land.
 Frederick, Esquimaux.
 Frost-bite.
 *Giffard, G. A.
 Girard, D.
 Good, J.
 *Gray A.
 *Guy, W. A.
 *Hamilton, R. V.
 Hand, J.
 Health, including weights of men.
 Subheads—1. Recent expedition.
 2. Former expeditions.
 Hill, E.
 Hindle, Alfred.
 *Hobson, W. R.
 Hudson Bay.
 Ice, ice-foot.
 "Intrepid," H.M.S.
 "Investigator," H.M.S.
 *Jenkins, W.
 Jones, F.
 Joseph Henry, Cape.
 Kemish, G.
 Lard.
 *Leach, H.
 Lectures.
 Leprosy.
 Lime juice.
 Subheads—1. General.
 2. In recent expedition and voyages.
 3. In former expeditions and voyages.
 4. In merchant service.
 5. Condensing or carrying it.
 Lorimer, W.
 *Lyll, D.
 *M'Clintock, Sir L.
 *Macdonald, J. D.
 *Markham, A. H.
 *May, W. H.
 Meat.
 Subheads—1. General.
 2. In recent expedition.
 3. In former expeditions.
 4. Musk-ox.
 Medical examination.
 Medical instructions.
 Medicines and medical appliances.
 Men, selection of.
 Subheads—1. General.
 2. Ages, height, &c.
 Merchant service.
 Milk.
 *Mitchell, T.
 Monteiro, Major.
 *Moss, E.
 *Munro, W.
 Murray, G.
 *Murray, W.
 Mustard and cress.
 *Nares, Sir G.
 *Ninnis, B.
 "North Star," H.M.S.
 O'Regan, M.
 *Ommanney, E.
 *Organ, J.
 Osborn, S.
 "Pagoda."
 *Parr, A. A. C.
 Paul, C. W.
 *Pavy, F. W.
 Pemmican.
 Peshawur.
 Petersen, N. C.
 *Piers, H.
 Pim, B.
 "Pioneer," H.M.S.
 Plants.
 Porter, G.
 Potash.
 *Pullen, W. J. L.
 *Rae, J.
 "Rattlesnake," H.M.S.
 *Rawlings, T.
 *Rawson, W.

Rayner, E.
Recreation.
"Resolute," H.M.S.
*Richards, G. H.
Richardson, Sir J.
*Robertson, J.
Ross, Sir J.
Rourke, J.
Sainsbury, .
*Scott, R. C.
Scurvy.

- Subheads—1. General: Causes, symptoms, treatment.
2. In recent expedition: Cases, symptoms, and general.
3. Do. do. Treatment.
4. Do. do. Causes.
5. In former arctic expeditions (including exemption.)
6. Other instances.
7. Whether carrying lime juice when sledging would have averted it from the recent expedition.

Self, J.
Shepherd, J.
Shirley, J.
Simmons, J.
Sledging.

- Subheads—1. In recent expedition.
2. In former expeditions.
3. Dogs and dog sledging.
4. Weights, sle ging.
5. Journeys other than sledging.

Sleep.
Smith, T.
Snow.
Snow-blindness.

Snow shoes.
Sorrel and scurvy-grass.
Spekboom.
Spirits.

- Subheads—1. General.
2. Rum.

*Stephenson, H. F.
Stuckberry, T.
Sylvester stove.
Symonds, R.
Taws, E.

Tea.
Temperature.
Thirst.
Thors, J.
Tide.
Tobacco.

*Toms, F. Y.

- Vegetables.
Subheads—1. General.
2. Potato.

Vegetation.
Ventilation.

- Subheads—1. General.
2. In recent expedition.
3. In former expeditions.
4. Condensation.
5. Advantage of heating air on admission.

Washing.
Water.
Wheat.
Winstone, G.
Wolley, W.
Wyatt, B.
*Young, A.

Former British Expeditions referred to in which witnesses served.

Armstrong, Sir A., "Investigator," 1850-54.
Bayley, R., "North Star," 1848-49; "Assistance," 1852-54.
Dickson, W., in Antares in "Pagoda," 1844-45.
Ede, C., "Assistance," 1850-51.
Hamilton, R. V., "Assistance," 1850-51; "Resolute," 1852-54.
Hobson, W. R., "Rattlesnake" and "Plover," 1853-54; "Fox," 1857-59.
Lyall, D., "Terror" (Antarctic), 1839-43; "Assistance," 1852-54.
M'Clintock, Sir F., "Enterprise," 1848-49; "Assistance," 1850-51; "Intrepid," 1852-54; "Fox," 1857-59.
Murray, W., "Investigator," 1848-49; "Enterprise," 1850-55.
Nares, Sir G., "Resolute," 1852-54.

Ommanney, E., "Assistance," 1850-51.
Organ, J., "Enterprise," 1848-49; "Pioneer," 1850-51, and 1852-54.
Piers, H., "Investigator," 1850-54.
Pullen, W. J. S., "Plover," 1848-50; "North Star," 1852-54.
Rae, J., Franklin Search Expeditions, 1848-49, 1850-51; and for Hudson's Bay Company, 1845-46, 1852-54.
Richards, G. H., "Assistance," 1852-54.
Robertson, J., "Enterprise," 1848-49.
Scott, R. C., "Intrepid," 1852-54.
Toms, F. Y., "North Star," and "Pioneer," 1852-54.
Young, A., "Fox," 1857-59.

ANALYSIS OF EVIDENCE.

ALDRICH, PELHAM, Commander, R.N.

Subheads 1. General (including Health, other than Scurvy, and while Sledging).

2. Diet.

3. Lime Juice.

4. Sledging.

5. Scurvy.

Papers handed in by—

Sledge party returns	No. in Appendix.
Remarks on Dr. De Chammont's estimation of work done sledging	18
	24

Reference to—

Dr. Colan—

Immunity from scurvy, 1968.

1. General (including Health, other than Scurvy, and while Sledging)—

Service in "Alert," 1252-3; no frost-bite in the autumn, 1258; definite work in air on floe before and after dinner preferable to walking exercise, 1303; great pains taken in ventilation, under supervision of the captain, 1303; men told off to wipe the condensation off the beams, 1303; the drying-room carefully looked after, 1303; the housing fitted with hatches which were thrown back, 1303; the Esquimaux and Greenlanders felt cold more than others in autumn, 1322; their clothing had to be supplemented, 1324, 1387; the Esquimaux most, 1387; the Esquimaux sealskin dress never thoroughly dry, 1324; immunity of Ayles from illness, cannot say whether due to abstinence, 1402; the Canadian snow shoe good, 1407; information to be furnished to Committee, 1408.

2. Diet—

Description of compressed tea, its advantage in measurement and strength, 1295; to what extent he used it, 1404; preference for tea at luncheon, but disadvantage of delay in making it, except when working half loads, 1296; suggestion to take a small amount of preserved meat when sledging, as a change on pemmican; pemmican excellent, but not suited to all; whole allowance of preserved meat (found in dépôt) eaten even by sick men, 1303; facilities for measuring off daily rations very advantageous, 1303; 1 lb. preserved meat used instead of pemmican and bacon in autumn, 1316-17; none in spring, except that sent to dépôt, 1331; water in autumn chiefly from melted snow, 1320; it was good, 1321; also in spring, 1370; did not find sorrel, cranberries, or other antiscorbutics, 1393; nothing but moss and a poppy, 1393; advantage of rum and tobacco at night, 1401; how the rum, pemmican, and tea was taken at night, 1401; only tried rum once at luncheon, and men suffered inconvenience, 1401; spirits should be taken sledging, 1403; advocates tea in the middle of the day, 1405.

3. Lime Juice—

Did not take lime juice sledging, 1271, 1289; whether it should be taken, 1272, 1373-7; objection to taking it in the tea, 1297; a ration is about two table spoonful a day, 1299; practicability of carrying it in a condensed form, 1301; difficulty of thawing it at night; it should be carried in something not easily broken, 1302; gave lime juice after finding it at dépôt, 1355-6; what amount he found, 1359; its condition, and the temperature it had been subjected to, 1360-62; being liquid, it only required thawing water to mix with it, 1379; it was not weaker than the ordinary, 1399; personally, took lime juice after finding it and on board, 1367; limitation to carrying antiscorbutics, if their use interferes with the journey, 1377; no experience of it as the sole antiscorbutic, 1378; was taken at sea, but has been seldom long without fresh vegetables, 1378; lime juice in "Challenger" given after four days at sea, 1394-5; it was taken with pleasure by sick men, but did no good, 1397; how he managed his issues; gave over the ration, 1398; recommends it being taken; doing so might shorten the journeys, 1400.

4. Sledging—

Enumeration of sledge journeys, 1254; the temperatures experienced, 1304, 1325; autumn journeys, account of, 1305-15; were all dog-sledges, 1312; absence in spring for 84 days on Grinnell Land expedition, 1254; description of journey, 1327; alteration in crews in autumn journeys, 1255; the only really hard work in autumn was on return, 1256; the snow being too deep for the

ALDRICH, PELHAM, *continued*—

dogs, 1318; but the very harassing work not of long duration, 1318; weight of sledge in spring = 242 lbs., 1260; Elias Hill sent back the eighth day by advice of surgeon, 1261-2; date of parting with support sledge "Poppie," 1265; health of crew then very good, with one exception, 1266-7; heavy dragging, but not impeded by hummocks, 1270; equipment same as the northern party, except boats, 1271; journeys chiefly on the sea, 1273; preference in travelling must depend on the state of the ice, 1274; nature of the land and ice he met, 1275-7; the ice between the ship and Cape Joseph Henry broken and hummocky, afterwards smooth ice but very deep snow, but heavy hummocks north of the land, 1277; the crushed ice may move with currents, 1278; the floe does not move, and a ship could not navigate round the north coast, 1278; no ice-foot existed except near the ship, 1279-81; to what extent it may exist in summer, 1282; to what extent the tide may affect the ice-foot, no great tide, 1286; how far the ladder sledge was used, 1283-4; the cracks in the ice small and deep, 1287-8; no medical comforts taken, 1293; minor alterations suggested in cooking apparatus, 1294; suggested alterations in sledge bearers, 1303; and in tent waterproof sheet, 1303; the dress good, except guernsey and drawers, 1303; fearnought drawers an advantage, 1303; alterations made in foot gear and travelling boots (which were too small), 1303; extra work devolving upon cook, 1303; arrangements for changing him daily, 1303; dog-sledging harassing work, from unequal pace, 1318; weights in the spring journey, 1329; double manning till 30th April, thus reducing weights to 125 lbs. per man, 1329, 1371; subsequent weights, 1329; dragged himself after 30th April, 1329; difficulty in computing weights where sick men are dragging, 1353; lectures given by Captain Nares on sledge travelling, 1348; what points were touched on in them, 1350; when met by Lieutenant May, A. Ayles alone was pulling up to ordinary strength, 1353; comparison of work with northern expedition; rather more weight at first, 1371; not so heavy after separation, though troublesome, 1371; description of snow in autumn and spring, 1380; difficulty in walking, caused by formation of crust, 1380; it was up to the knees, 1380; continuous progression by double manning or half loads depressing, but men cheerful, 1381; how far the work overtaxed the strength, 1382; ease of dragging with only 4 inches snow, 1382; low spirits due to illness and fear of unfavourable comparisons, 1383; their enthusiasm great, and it aided them in their work, 1384-5; attributed illness of marines to strain of drag-belt on chest, 1333, 1388; the men dragged from the shoulder, 1388; snow shoes would have been useful for the officer, but not for dragging, 1406; would lighten the work if symptoms of scurvy came out, not otherwise, 1409.

5. Scurvy—

No symptoms of disease, in spite of heavy work in autumn, 1257, 1322; date of attack of James Doidge, 1268, 1346; the whole crew attacked except Ayles and Mitchell 1268; when and why he detected it to be scurvy, 1269, 1358; earlier attack of the northern party due to very rough read and consequent sudden jerks, 1270; were ordered to use scurvy-grass and sorrel if obtainable, 1291-2; but did not get any, 1292-3; first appearance (in Sergeant-Major Wood), 1268, 1290, 1332, 1339, 1372; attributed illness of Wood and Hill to method of dragging, 1333, 1388; Wood less able to pull than others, but did not complain till 30th April, 1340; his symptoms, 1340-43; not ill enough to send back, 1343; symptoms of James Good, and date of attack, 1344-5; attributed stiff legs to natural result of sledging, 1347; lectures given by Captain Nares on sledging did not allude to scurvy, 1349; had no instructions as to it, 1351; condition of crew when met by Lieutenant May, 1353, 1363; all ill of scurvy, 1363; unable to give relief when scurvy was recognised, 1354; gave lime juice after reaching dépôt at Cape Colan, 1355; danger of delaying to look for sorrel, for fear of the thaw, 1355; advanced slowly, to enable sick men to walk, and by this exercise prevent their going down, 1363; Ayles ill of scurvy, but pulled till he reached the ship, 1364-5; personal immunity, but had a sprained ankle, 1366; no deaths occurred, 1369; complaints in the chest not due to dragging, 1389.

ARMSTRONG, SIR ALEXANDER, K.C.B., LL.D., F.R.S.,
Inspector-General of Hospitals and Fleets, and Medical
Director-General.

- Subheads 1. General.
2. Diet, General.
3. Diet on board.
4. Diet, Sledging.
5. Discipline.
6. Lime Juice.
7. Medical Examination, Selection of Men, Health.
8. Medical Instructions.
9. Routine, Exercise, Washing.
10. Sledging.
11. Scurvy.
12. Ventilation.

Paper handed by—
Scurvy in former expeditions No. in
Appendix. 30

1. General—

“Investigator,” 1850 to 1854—

Account of voyage in 1850, 8931; nearly five months reaching the Sandwich Islands, 9186; hardships in working through the ice on the North American coast and in Prince of Wales Strait, first winter at Princess Royal Isle, during this winter in a perilous situation, 8931, 9193-4; ship drifting in the ice till October, 9195-6; in 1851 arrival at Baring Island, 8931-4; and Mercy Bay; the second and third winters passed here, being unable to extricate themselves; rescue by Lieutenant Pim travelling in very low temperature, 8931, 9223; the fourth winter spent on board the “Resolute” and “Intrepid,” journey to Beechey Island in 1854, 8931; his offer in 1851 to communicate with Melville Island, suggestion not carried out, 8937-8; what degree of cold was experienced, 8965-6; hardships and labour in voyage to Mercy Bay, 9206-8; labours subsequently confined chiefly to hunting, which often caused exhaustion, 9208; abandonment of the ship, 9224; thermometers tested before and corrected when mercury froze, 9263-5.

The senior medical officers of the late expedition selected for professional claims, 9283; their services have been recognised, 9284; the ships of the late expedition the best equipped that ever left England, 9267.

2. Diet, General—

Salt meat not so nutritious as fresh, and hence predisposes to scurvy, 8957-9; suggestion to Arctic Committee that other means of preserving meat besides salting should be found, 8961; has no experience of preserving beef in sugar, 8962; animal food raw, or partly cooked, may keep off scurvy, 9002-3, 9167-8; there is a large amount of lactic and phosphoric acid in raw meat, 9003; more food, especially fatty food, required in a cold climate, 9148-9; uncooked potatoes more antiscorbutic than cooked, 9161; to what extent pemmican with currants is antiscorbutic, 9164; but prefers it plain, 9169; milk an antiscorbutic, 9172; potato is antiscorbutic, but not as much so as lime juice, 9275-6.

3. Diet on board—

In “Investigator,” 1850—

Fresh meat obtained at the Sandwich Islands, but no vegetables, 8935, 9191; no fresh food before, except some beef, 9187; reasons for scarcity of vegetables, 9191; diet very inferior to recent expedition, less meat and vegetables, 8954; large amount of meat eaten when obtainable by sledge parties, 8956; occasionally got fresh meat, 8976; to what extent, 8977; much sorrel obtained in 1852, used as salad, 9034-5; very little fresh food obtained along the coast of America, 9192; considerable amount of meat obtained at Mercy Bay, 9209-10; in Mercy Bay provisions limited, 8939; reduction in amount of meat and other food, not vegetables, 9212; fresh meat a substitute for, not a supplement to, other food, 9214; no change in diet till abandonment of ship was decided on, 9223; liberal allowance on board “Resolute,” 9229; more fresh meat obtained than before, 9240; the dietary better than before, 9241; opinions of men as to sufficiency of diet not asked in “Investigator,” 9272.

In Recent Expedition—

Not sufficient for lengthened arctic service, 8956; recommended two pounds, but not two pounds without bone, a-day, so as to give meat three times a-day, 8956, 9061; men should have been made to eat it, 8956; recommendations not carried out, meat not given for breakfast or supper, 9061; the objections he made to the scale proposed as not good enough to keep off scurvy, and maintain health, 9243; quantity of food sent out increased, 9244; but the ration did not come up to what he had advised, 9245; the deviation from his views as to diet had not affected the men's health, 9124; average increase of weight of men considerable, 9139; greater increase in “Discovery” points to more nutritious diet, 9140; Captain Nares was left at liberty to use what diet he pleased, 9266; it was not as varied or equal in amount to what he had recommended, 9269; doubts there having been any want of appetite on the part of the men, 9272.

4. Diet, Sledging—

Rum might be dispensed with, but adds to the comfort of men after work is over, 9011; they do not work so well

ARMSTRONG, SIR ALEXANDER, *continued*—

on it, tea is preferable for lunch, 9012; objection to long halts for luncheon, 9013; the vegetable element in the recent sledge diet too small, 9113-14; what pemmican they had in “Intrepid,” did not like the sweetened, 9170; the effect of the potato and other antiscorbutics taken in the recent expedition very feeble, 9274; would omit some pemmican and sugar so as to take lime juice, 9281; advantage of taking rather fewer days' provisions, 9282.

5. Discipline—

Absence of free communication between Captain Nares and the medical officer as to what was most suitable for sledge travelling, 9055, 9287; the captain should have originated the consultation, 9287; the medical officer had concluded his duty when he represented lime juice should be taken, 9288; but might have made a written remonstrance, 9288-9; this, however, not absolutely necessary, 9289; remonstrance by medical officer of “Discovery” not fully enough done, but the adoption of the same dietary as the “Alert” was compulsory, 9290; how far Dr. Colan was justified in not writing a remonstrance, 9291; no remonstrance shown by the doctor's evidence, but Sir G. Nares has accepted the responsibility of the omission of lime juice from the sledge diet, 9295-7; it is not incumbent on an officer to express his remonstrances in writing, 9302; drew up a paper of recommendations and suggestions for the recent expedition, which were referred to in the sailing orders, and consequently considers they should have been regarded as orders, 9041, 9285-6; did not refer to any great extent to scurvy, because he anticipated his recommendations as to lime juice would be carried out, 9089; adheres to what he drew up, 9268; aware that the recommendations were sent to the ships for information, not for guidance, 9285-6.

6. Lime Juice—

Was regularly taken on board “Investigator,” 8939, 9199; health of crew maintained by this, 9198-9; one ounce a day given, 9200; bad effects of the reduction in 1852, 9216; it will not lose its antiscorbutic properties by keeping, 8990; or by freezing, 8991-3; or change of temperature, 9107-8; analysis of that of the “Alert” and “Discovery,” the soundness of the samples, 9109; it is the best substitute for fresh vegetables, 8994-5, 9110-11; more a food substitute than a medicine, 9110; is only a substitute, and not so efficacious as fresh fruit and vegetables, 8997; citric acid the next best antiscorbutic, 8999; but is not reliable, its properties being feeble, 8999-9001, 9005; lime juice not sent sledging from the “Investigator,” the quantity being insufficient, 9005, 9203; crystallised citric acid sent, 9005-6, 9203; is unaware if it was taken, 9007; lime juice was not carried in former long journeys, 9175; no difficulties of carriage should prevent its being taken, 9178; no difficulties should have prevented its being sent on the sledge parties of the late expedition, 9008; suggestion to mix it with rum, tea, or pemmican, 9008, 9016, 9093; at the time of using only, 9177; it would have assisted assimilation of food, 9008-9; and thus prevented the debility arising from exhaustion and want of appetite, 9093; an ounce a day enough, 9015; other articles might be dispensed with rather than it, 9016; if taken in accordance with his recommendations, it would have prevented scurvy and other affections, 9090, 9019-20; no advantage in the double allowance given before starting, 9022; no diminution takes place by length of administration of its prophylactic powers, 9112, 9023-4; would not increase it except if disease breaks out, 9024, 9112; attached importance to it in his instructions, owing to previous experience, 9085-6; considers the medical officer of the “Alert” had concluded his duty when he represented it should be sent sledging, 9287-9; but he might have made a written remonstrance, 9288; whether the remonstrance was sufficient in the two ships, 9290-95; it can be carried sledging, and used in very low temperatures, 9091-2; suggestions for carrying it in wooden breakers or tins, 9093-4; objection to taking it in a frozen state, 9095; should be mixed with rum and tea, 9096; objection to trying lime juice lozenges or extracts on the men without full previous trial, 9098, 9104-5, 9171, 9179-85; is not satisfied with lozenges of lime juice, though chemically satisfactory, 9100-9103; and possibly a desirable mode of carrying it, 9105; nor with any substitute, unless proved by experience equal to it, 9103-6; possibility of trying experiments, 9183-4.

7. Medical Examination, selection of Men, Health—

All the crew of “Investigator” examined before starting by himself or his assistant, 8932-3; monthly examinations held on board the “Investigator,” 8939; health fell off after second winter, and reduction of provisions, 9025; it was good on arriving at the Sandwich Islands, 9189; frost-bites on sledging parties, 1851, 9201; parties in good health on return, especially one which had fresh meat, 9204; inability to do hard work in 1852, 9219; improvement on board the “Resolute,” 9225-30; Sir L. M'Clintock's sledge crew, on return to “Resolute,” much broken, 9232-4; “Investigator's” crew in almost

ARMSTRONG, SIR ALEXANDER, *continued*—

as good health as the "Resolute's" the last year, 9238; except a few cases, 9238-9; men of late expedition proved by examination to have been healthy, vigorous and fit for their work after the winter, 8979-82-3, 9124; but perhaps might have diminished vigor, 9124; the pallor shown incidental to arctic service, and not an incipient sign of scurvy, 8981-3; anæmia incidental to polar service after the winter, 8980; men fresh from England would not have been in better state for the work, 8984; absence of sun and light has no material effect on the system, unless combined with other causes, 8985-7; what effect absence of light has, 9130-4; it will not produce scurvy, 9132; his views as to the selection of men stated to Arctic Committee, 8934; does not object to the ages of the men in the late expedition, 9301; the best men for arctic service are man-of-war's men from 20 to 30, 9301.

8. Medical Instructions—

He supplied the medical handbook for guidance of sledging officers, 9083; supplementing information as to scurvy by supplying his book on naval hygiene in order that officers might acquaint themselves with early symptoms of scurvy, 9084, 9278.

Medical Instructions given to Sledging Officers—

Some verbal instructions as regards scurvy must have been given, 9042; some instructions should have been given, 9043, 9279; as it would have enabled the sledging officers to detect the disease, 9048, 9300; desirability of this if scurvy was apprehended, 9053; but they could not have treated scurvy, not having the means, 9049, 9279; possibly omitted to refer it on account of the omission of the remedy, 9052; assumption that scurvy had been talked of and its symptoms known, 9054; references to scurvy grass and sorrel point to scurvy having been discussed, 9055; the instructions sufficient, 9080; the officers should have been acquainted with symptoms of scurvy, 9279; the captain should have suggested insertion of instructions as to scurvy, 9298-9; instructions should have been given by the captain to the sledging officers what to do in case of scurvy breaking out, 9043-50, 9279-80; sufficient medical appliances sent sledging, 9079-81.

9. Routine of the Ship, Exercise, &c.—

In "Investigator"—

In Mercy Bay, five and a-half hours daily exercise taken, 8939; daily exercise and hunting sufficient training, 8970; to what extent they overtaxed their strength, 8971-2; hardwork in hunting, 9208; inability of crew to work in 1852, 9219; in third winter only a few able to hunt, officers made a point of doing so, 9221-2.

In recent Expedition—

The amount taken, as mentioned in evidence, was sufficient to preserve health, 8967; not taken as recommended, 8968, 9061, 9271; more sledge exercise in the spring desirable, 8968; assumption that regular exercise was not taken, as it is not logged every day, 8969, 9061; exercise was only for two hours a-day, and that not compulsory, but exceptional, 9061; nothing to show it was taken as recommended, 9271; want of appetite points to want of exercise, and is unusual in Polar regions, 9271.

Washing—

No regular system of washing in "Investigator," men got water once a-fortnight, officers tepid water once a-week, 8947.

10. Sledging—

The Pole can only be reached by dépôts, or in a ship, 9147; journey by Lieutenant Pim to inform "Investigator" of relief, 8931; adoption by Captain McClure, owing to heavy ice, of travelling six hours at a time, 8973; which was a judicious arrangement, 8973, 9013; the sledging of the late expedition very severe, more so than that of the work of "Investigator," 8974-5; the weights taken in late expedition excessive, especially with the work, 9017, 9146-7; the northern party's task impossible (on assumption that they were to reach the Pole), 9147; not more than 40 or 45 days', or 200 lbs. a man, equipment should be taken, 9147, 9282; want of appetite infers over-exhaustion, 9150; exhaustion produced, though less exposed to drag rope than other expeditions, 9246; the nature of the snow and walking in it, produced greater exhaustion, in spite of double-manning, than in previous expeditions, 9247; a standing pull more exhausting than a continuous drag, 9248-9.

In "Investigator"—

Only 170 lbs. a man dragged, 9147, 9205; sledging in first autumn, 9197; to confirm discovery of north-west passage, 9197; amount done in 1851, 9201; weights carried, 9205; in 1852, only one journey to Melville Island, 9217-18; sledge journey to "Resolute," advantage of travelling alternate six hours, 9226; some men carried, 9227; weights under 200 lbs. a man, 9228.

11. Scurvy—

Scurvy, Causes of, &c.—

Bad air on the lower deck would deteriorate the constitution, 8952; Esquimaux have scurvy, 9040; salt meat conduces to, 8957-60; would not produce it without absence of vegetables, 8958; cold, or any

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cause lowering the vital powers, predisposes to it, 8963-4; to what extent arctic conditions promote development of the disease, 8988-9; other causes in action at the same time, as absence of vegetables, will promote it, 8989; it has no respect for race or colour, 9039; loss of weight a sign of incipient scurvy, 9137; reasons for immunity of Sir L. McClintock's party in 1853, and other long journeys, without lime juice, 9021, 9176; belief that symptoms did exist, and that a man died of it after two years' travelling, 9021; immunity of Polaris party on the floe due to raw meat, pemmican mixed with fruits, absence of exertion, and living in uninvited air, 9162-66.

In "Investigator"—

Broke out in the spring of 1852, 9026, 9215; partly due to reduction of lime juice, 9216; none the first year or the second till the reduction of rations, 9030; none of the crew free when the ship was abandoned, 9031, 9222; but some were capable of exertion, 9222; three deaths when in want of food, 9032; two after leaving the ship probably due to it, 9033; a coloured Canadian was ill of disease, no difference in his symptoms, 9036-38; growing scorbutic tendency in 1852 due to want of animal or vegetable food, 9219; which diminished physical power, 9220; improvement in health on determining to leave the ship, 9225; and on board "Resolute," 9230.

In recent Expedition—

The number of cases, 9116; to what extent they occurred in sledging, 9118; the conditions of the winter had not produced scurvy, 9125-6, 9156; and would not do so, 9126-8; absence of light would not account for difference in number of cases in the two ships, 9130-1; over-taxing of strength would not have produced scurvy without the absence of lime juice, 9142; it was due to over work and absence of lime juice, 9141-3; imagines exhaustion prevented the men eating their allowance of food, 9143; with consequent waste of strength, scurvy would occur rapidly, 9150-52; and is not surprised at the unprecedentedly rapid occurrence of scurvy under the conditions, 9153-6; suggestions for accounting for its occurrence in the cases not due to sledging, 9158; no scorbutic taint existed among the crew, 9159-60; remarks on eight cases not to be accounted for by exposure to great fatigue or long absence sledging, 9250-62; similar cases never occurred on board the "Investigator," but imagines the prescribed exercise was not taken on board "Alert," 9262; did not anticipate scurvy, if his suggestions had been carried out, informed Captain Stephenson before leaving they need not expect scurvy the first and second winter, 9267-8; the sledges should have returned on outbreak, 9277, 9300.

12. Ventilation—

In "Investigator" the supply of coal was reduced from seventy to fifty pounds a day, 8946; the "Investigator" was warmed by the Sylvester stove, 8940; account of this stove, tubes communicating with cabins, dissemination of hot air through the ship, 8940-41; it communicated with the outer air, 8942-3, 9070; not directly, 9070; preference for it over mode of ventilation of recent arctic ships, 8944-5; provided there is a good supply of coal and it can be kept alight, 8945-6; funnels for ventilation opening above the housing, 8948; rarified air would rush out like steam, 8948; had no means of testing the air, 8949; but fancies matters were worse in "Investigator" than in late expedition, 8951; difficulty in keeping lower deck of polar ships pure, 8948, 9064; owing to difficulty of renewal of air, the cold being one obstacle, 9072-3; how far possible to heat the air previous to distribution without increase of fuel, 9073-75; desirability of doing so if possible, 9076; doubt as to reliability of experiments in late expedition on carbonic acid in air, 8950; no estimations of air have been made in other ships, 8953; air in "Alert" not pure, but probably better than in "Investigator," 9065; to what extent the estimations of outside air of "Discovery" may have been faulty, 9066-69.

BARNES, ROBERT, M.D.

Subheads 1. General.

2. Diet on Board.
3. Diet, Sledging.
4. Lime Juice.
5. Scurvy, causes of.
6. Scurvy in recent Expedition.
7. Scurvy, instances of.
8. Ventilation.

1. General—

A Fellow of the Royal College of Physicians, 7020; many years Physician to the "Dreadnought," 7023; author of a Report on Scurvy, prepared for the Privy Council, 7021-2; disbelief in acclimatisation, 7068-9; what effect absence of light has upon printers, miners, &c., their want of red particles of blood, 7103; would not select men for arctic service under twenty-seven or twenty-eight, 7134; the constitution being then more formed, 7135; sledge-training an advantage, 7149.

2. Diet on Board—

That of the late expedition admirable up to a certain

BARNES, ROBERT, *continued*—

point for a certain time, 7049; would require more vegetables after exposure to conditions likely to produce scurvy, 7051; preserved milk might be added as a general ration, 7053-4; recommends more potatoes and fruit, and modification of the vegetables, 7054; beer, being decidedly antiscorbutic, should be given instead of spirits, 7055; scurvy would not occur for a year under the modified diet without great hardships sledging, 7057-8; but without such modifications, it was becoming insufficient as a preventive, 7059; scurvy must have occurred, 7071; milk has excellent effects as an antiscorbutic, 7077; children thrive upon it, 7082; eggs not so antiscorbutic, 7078-82; objection to alcohol, except in very small quantities, its sudden abstraction not injurious, 7112; in any future arctic diet, would suggest increase of vegetables after six months, 7118; raw meat most antiscorbutic, as cooking coagulates the albumen, 7122-3; immunity of "Polaris" party perhaps due to it, 7122-5; doubt whether any people live for long on raw meat, 7126; but it might be an equivalent for fresh vegetables, 7148; raw potatoes probably more antiscorbutic than if cooked, 7136.

3. Diet, Sledging—

The potatoes insufficient in amount, 7045; very defective in vegetable diet, 7061; pemmican not antiscorbutic; has no faith in it as meat, 7061-2.

4. Lime Juice—

Lime juice the most available and effective substitute for fresh vegetables, 7034; it supplies a want of vegetable food, 7111; introduction in the navy in 1795, 7036; if it had been carried in the recent expedition, scurvy would have been postponed for a time, not prevented, 7073-5; its absence hastened the outbreak, 7110; to what extent the sudden abstraction is hurtful, 7112; the double allowance given before sledging very judicious, 7119; possibility of concentrating lime juice, but difficulty of experimenting on men, 7131; danger of trying it without experiments, 7142; a sailor too valuable to risk trying it on, 7142; chemical opinions not sufficient, 7143; too much heat would impair antiscorbutic power, 7131; one and a-half ounce a day daily ration should be taken sledging, 7137-8; the ration on board of one ounce should be increased, 7139-40; its virtue depends on the combination of its constituents, 7150; its water not essential, 7151; extracts may be found by experiment to be valuable, 7152; citric acid has not the virtue of lime juice, 7154-7; experiments with, on board the "Dreadnought" not satisfactory, 7158; but had reference only to the curative power, 7159; it may be valuable as vinegar is, but is not a substitute for lime juice, 7162; the potash compound broke down, 7155-6.

5. Scurvy, Causes of—

Privation of vegetable the one constant condition of it, 7025-32; it has occurred in combination with every other variety of conditions, 7032; the officers in the merchant navy completely exempt, owing to superior diet, every other circumstances being alike, 7033, 7092; confinement during the winter must render men more liable to scurvy without proper diet, 7065; absence of light, exposure to cold, and bad air would impair nutrition, 7066-7; and have an influence in production of scurvy, 7101-2; being powerful predisposing causes, 7105, 7145; but cannot produce it, 7145; is unaware of any case in which there was not a defect of vegetables, 7086; accepts this as an axiom, 7113; thinks scurvy must occur in absence of all fresh vegetables, 7087-8; possibility of cases of its non-occurrence, 7090-91; no difference in symptoms wherever cases came from, 7085, 7164-5; deterioration of blood and pallor of the tongue symptoms of it, 7104; scurvy is a disease of gradual degradation due to absence of vegetables, not of incubation, more open to the attack with exposure, 7108-9; inability to explain the numerous cases in which travellers in the arctic have lived for months on a diet without vegetables, yet with immunity from scurvy, 7115; presumes there is some explanation not to be got at, 7115; the resisting powers of individuals differ, 7117; opinion on immunity of "Polaris" party on the floe, case requires observation, possibly due to eating raw meat, but does not justify dispensing with lime juice or vegetables, 7120-26; fresh vegetables and fruit prevent and cure it, 7146.

6. Scurvy in late Expedition—

Due to defective amount of vegetable food and great fatigue and cold, 7044-5; its early appearance sledging not surprising under previously unhealthy conditions of life, and diet not sufficiently antiscorbutic, when called on for extraordinary exertion on a deficient diet, 7068, 7072; special training would not have warded it off, 7070; scurvy must have occurred under the diet on board, 7072; immunity of officers due to same causes as their immunity in merchant ships, 7092-3; comparative severity of attack in "Alert" due to health being more broken down by deteriorating circumstances before sledging, 7094-5; pallor of crews after winter denotes degradation of blood and impairment of nutrition,

BARNES, ROBERT, *continued*—

7103; a crew quite fresh from England would have withstood sledging for two or three months, 7106; had expedition wintered in more southern latitude, it would have withstood the disease longer, 7107; the comparative absence of vegetables undermined the system, 7109; absence of lime juice hastened the outbreak, 7110; ease of scurvy not due to sledge travelling bears out the relative insufficiency of the diet on board, 7117.

7. Scurvy, instances of—

Outbreak in Scotland, 1846-7, when potato crop failed, and on a diet of bread, coffee without milk, and salt fish and fresh meat, 7026-7; no vegetables, 7026-7; food taken from Tommy shops of contractors, 7027; existence of scurvy amongst Crusaders, 7029; formerly in Holland, when badly drained, and the diet salt pork and beef, 7030; cessation of it since the production of vegetables, 7030; no scurvy on board ship in the navy in the Crimea, but it existed on shore, 7031; cessation of scurvy in the navy since the introduction of lime juice and vegetable food, 7035-7; is consequently not surprised at its not being recognised at first in the late expedition, 7037; for the same reason, it has ceased in the emigration service, 7038; the quantity of lime juice and vegetables being large, 7039-41; it occurs in from sixty to seventy days in the merchant service, but men in the navy should hold out longer, 7048; length of time for production varies with circumstances, 7048; from what parts the greatest number of cases were sent to the "Dreadnought," 7080; Hamburg ships especially, 7080; what the treatment was, 7082; rest important, 7082; milk, potatoes, soup, oranges, and watercress given, 7082; instance of an attack in the "Gorgon," in the River Plate, with little fresh meat, and no vegetables or lime juice; recovery on oranges and fresh meat; immunity of a French ship under similar conditions, but with wine and beer, 7097, 7127-9; one death, 7127; attack at Ottawa among lumbermen, in absence of vegetables, where nitrate of potash was used in salting meat, 7163.

8. Ventilation—

The ventilation of the "Dreadnought," well cared for, 7083; advantage of ventilating arctic ships with hot air, 7084.

BAYLEY, RICHARD, Boatswain, R.N.

Subheads 1. General.

2. Diet.
3. Diet, Sledging.
4. Lime Juice.
5. Sledging.
6. Scurvy and Health.
7. Ventilation.

1. General—

In the "North Star" 1849, and the "Assistance" 1852 to 1854, 6245.

In the "North Star"—

Service in, 6249; it was a store ship to Sir John Ross, 6438; passed the winter unexpectedly, 6255; had plenty of exercise and was personally healthy, 6262; what the exercise was, 6303; about four hours a day, 6339; Esquimaux in the neighbourhood, 6304, 6440; no signs of scurvy, 6308; illness of one from frost-bite, 6305-7; ship not prepared for wintering there, frozen in eleven months, 6313; darkness lasted ninety days, 6337.

In the "Assistance"—

Arrangements for washing, 6278-80; arrangements for bedding and berthing, 6446-55; slept in a hammock, 6446-7; had no screen from hatchway, 6511-12; no advantage from Sylvester stove, 6514; the berthing not changed, 6454-5; the men got sufficient and refreshing sleep, 6457-9; description of the clothing, 6473; the difference made on coming on board, 6474; what the routine was, 6476-80; what amusements were provided for, or adopted by the men, 6485-8; sledge training, dragging weights, and walking exercise, 6524-5-7; sent out for walking about six times, 6526; age for men should be from twenty to thirty, 6309-10.

2. Diet—

"North Star"—

Provisions ran short, 6260-63; used to pipe hands to grass, 6299; grew mustard and cress, 6301; had Edwards's potatoes, 6302; badness of the preserved meats supplied, 6314-8, 6329; what the other meat was, 6330; and the vegetables, 6331-3; but little game, 6363-5, 6439.

"Assistance"—

Allowance full and sufficient, 6264-5; biscuit saved, not meat, 6265-7; what the meat and potatoes were, 6269-70, 6349-53; potatoes twice a week, 6270-71; not every day, 6353; vegetables every day, 6352; no game obtained, 6366-7; what their breakfast was, 6478; no general complaint of the diet, 6481; the salt meat expressly provided, 6482; it was liked as much as preserved meat, 6483.

3. Diet Sledging—

Bacon, pemmican and potatoes, 6286-91, 6377-82; had enough, and ate all, 6289-90; how the pemmican was cut and weighed, 6288; no preserved vegetables, 6376; one

BAYLEY, RICHARD, *continued*—

deer shot, 6378; the pemmican was of three kinds, with currants, sweet and plain, 6380-1; preferred with currants, 6382; no sorrel obtained, 6383; rum was taken for lunch and liked, 6391-3; was beneficial, 6394; men worked well after it, 6499; advantages of giving it on camping before tenting began, 6528; tea popular at night, 6500-1; tobacco enjoyed, 6503.

4. Lime Juice—

In "North Star"—

Was taken regularly, but in the messes not under supervision, 6257-9, 6334, 6356-8; one ounce a-day, 6335-6; did not drink it often, 6341; his messmates drank it, most liking it, 6342-7.

In "Assistance"—

Half-pint with water the daily ration, 6273, 6354-5; was sent to messes, 6274, 6357; seldom took it himself, 6275, 6361; not liking it, 6296; no compulsion about taking it, 6297-8; no supervision, 6354-62; his was drunk in the mess, not by himself, 6361-2.

Sledging—

Did not carry it sledging, 6292, 6374.

General—

Had no reason for not taking it, except distaste, did not take it on the coast of Africa, 6495-6; has a good opinion of it, though he seldom drank it, 6522; understood it was given to prevent scurvy, 6523.

5. Sledging—

Enumeration of sledge journeys, was under Admiral Richards, 6246-8, 6370-3, 6504; the sledges were man-sledges, 6384; the work hard, ground sometimes difficult, 6385-6; occasional rests on account of weather or to dry clothes, 6387-89; travelled sometimes by night, 6390; in order to avoid the effect of sun on the eyes, 6491; weight in first journey 240 lbs. and a boat, 6402; injurious effects of extreme cold in a journey in February, 6419-35; loss of appetite entirely due to cold, 6494; the ice was difficult and hummocky on several occasions, 6492-3, 6505; character of ice and snow on respective journeys, 6504-10; seldom had to make roads, 6505; very heavy work over Melville Island, 6506; sank a foot or more in snow, 6508; runners would sink in it occasionally, 6510.

6. Scurvy and Health—

In "North Star"—

Believes there was no scurvy, 6251-6, 6320, 6327; crew healthy, 6250, 6321.

In "Assistance"—

Good health during sledging, or at least able to do work, 6293-5, 6397-9; suffered from snow-blindness, 6294; what the health was, and the appetite, in his journey, 6397, 6434-5; no suspicion of scurvy, 6416; a little weaker on return from longer journey; two days' rest given, 6411; injurious effects of cold on his third journey, 6417-35; inability to eat, 6422; suffered from intense cold in the inside, 6423; abandonment of sledge, 6421; remained some days in "North Star," and completed journey in good health, 6427-35; scurvy was discussed among the men on several occasions, 6489; scurvy in recent expedition; men not enough exercised, 6324-6.

7. Ventilation—

In "North Star"—

Warmed by stoves, had not the Sylvester stove, 6252-3; much dampness, 6311; means of removing it, 6312; their warming apparatus rigged up impromptu, 6515; what it was, 6516-19; not so comfortable as the "Assistance," 6519.

In "Assistance"—

Pleasanter than the "North Star," 6276, 6520; owing to Sylvester stove and better accommodation, 6277; not much moisture to complain of, 6281-2, 6467-8; a little the first winter, 6460; improvement the second winter in hatchways and awnings, 6284-5; description of the door over the hatchways, 6470; no complaint of admission of cold air, 6471; the lower deck comfortably warm at night, 6453; the drip not distressing, 6466; the deck covered with a foot of snow, 6463-4; advantage of this, 6465; the lower deck very comfortable, 6475; Sylvester stove did not come before the fore part of the fore hatchway, 6513.

BEAUMONT, LEWIS ANTHONY, Commander, R.N.

Subheads 1. General (including Exercise and General Health).

2. Diet.

3. Lime Juice.

4. Sledging.

5. Scurvy.

6. Ventilation and Accommodation of Ship.

Paper handed in by—

Sledge party returns No. in Appendix. 16

References to—

His illness (Lieutenant Rawson), 1097-8; worked hard sledging, and suffered from scurvy (Dr. Coppinger), 2973.

1. General (including Exercise and General Health)—

Service in "Discovery," 840-1; the lowest temperature

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2. Diet.

3. Sledge Diet.

4. Lime Juice.

5. Scurvy, General.

6. Scurvy and Health in the recent Expedition.

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BUZZARD, THOMAS, M.D., F.R.C.P.

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2. Diet.

3. Diet, Sledging.

4. Lime Juice.

5. Scurvy, definition of, and symptoms.

6. Scurvy, instances of.

7. Scurvy in recent Expedition.

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CAMERON, VERNEY L., Commander, R.N., C.B., D.C.L.

Subheads 1. General.

2. Diet and Conditions of Living.

3. Scurvy and other Disease.

4. Scurvy, treatment of.

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COLAN, THOMAS, M.D., Fleet-Surgeon, R.N.

Subheads 1. General.

2. Diet.

3. Diet, Sledging.

4. Health of Men and Medical Examinations.

5. Lime Juice.

6. Medical Instructions and Appliances.

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References to—

Color-Sergeant Wood—

Very attentive and worked hard, either he or Dr. Moss present night and day, 8039-46; what assistance they gave in nursing, 8047-52; their time all occupied by the cases, 8044-5.

1. General—

Service in "Alert," 1613-14; did not engage in any sledge journeys, 1615; was in medical charge of "Alert," 1619; seventy officers and men on board, 1622; complete darkness for fifty days, except for the moon, 1631; a certain amount of exercise taken, 1633; but men greatly confined to the ship, 1634; when on board the men lived on the lower deck, 1638; date of sledges starting, 1743; not consulted as to their equipment, 1744; observations made on ozone of the air, 2040-42; how far absence of ozone has a debilitating effect, 2043-7; small amount of electricity, 2045; no thunderstorms, 2046; antiscorbutics used by the Esquimaux, 2096; white people deteriorate in extremely high latitudes, 2106; a good deal of vegetation round the winter quarters, 2154; possibility of too long journeys having been made in beginning sledging, 2169; always felt free to make any representations he thought proper, 2171; how far satisfied with equipment, 2172; information to be furnished to Committee, 2173.

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3. Diet, Sledging—

Not consulted about sledge dietary, 1746-8-9; was not slighted, 2170; was aware of its nature, 1745-7; and could have expressed his opinion, 1750; it was totally different from ship diet, 1778; was very good, 1779; and if consumed, good for hardworking men, 1780; two

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kinds of pemmican, 1782; the plain generally used, 1783; account of preparation of both kinds, 1784; it did not produce thirst, 1786; Edwards's preserved potato supplied, 1787; description of it, 1788-9; slightly boiled before eating, 1790; was liked by the men, 1791; rum only used going to bed, 1794; was found beneficial then, 1792-3, 2017; rum ought not to be dispensed with, 2017; preference for tea over rum for luncheon, 2022; men more vigorous and able to endure fatigue, 2023-4; advantage of compressed tea, 2127; chewing tea leaves not antiscorbutic, 2141-2; no harm in tobacco, 2143.

4. Health of the Men and Medical Examinations—

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5. Lime Juice—

One ounce of lime juice taken daily, 1678-9; ration doubled in March before sledging, 1680-82; was not consulted as to increase, 1683; did not object to it, 1686; had plenty of opportunity to do so, 1687; it was given to Petersen when ill, 1700-1; and before, 2118; extra allowance after appearance of scurvy, 1702; one ounce before, 1702-7; thinks now, that a larger quantity was requisite to prevent scurvy, 1706-8; was thoroughly satisfied with the quality of the lime juice, 1703; it was good all through, 2094; extra allowance given to G. Kemish, ward-room steward, for fear of scurvy, 1720-21; it was supplied to Kemish and Burroughs regularly before their attacks, 2118; lime juice most useful in sledging, 1761; if necessary should be sent instead of rum, 2092; it should be sent, 2158; was aware of exclusion of lime juice from sledge dietary, 1751; was not consulted about sending it, 1753; suggested its being sent, 1756, 2175-6; but he gave no reason for doing so, 1759; understood it could not be sent, unless other essential things were left out, 1756-60, 2055; did not see means of remedying objections to its weight, and that of fuel for melting it, without reducing extent of travelling, 1762; understood these were the objections, 2055; description of preparation of lime juice, 1763; found that supplied good, except one jar, 1764; its colour and taste, 1765-6; what its constituents are, 1767; to what extent citric, malic, and tartaric acids contain its antiscorbutic principles, 1768, 2072; crystallized citric acid would not possess its properties, 2073; possibility of carrying these acids instead of it when sledging, 1772-3; possibility of extracting water and concentrating the lime juice, 1776-7; advantage of this as regards carriage, 1777; doubt about taking it in a condensed form, 2159-61; it might be carried in bags when frozen, 2093; increase of allowance given to G. Burroughs when suspected of scurvy, 1824-; dates of increase, 1825-30; up to three ounces a-day given in treatment of other patients, 1993-6, 2071; men mended under it, 2071; absence of it when sledging, may account for scurvy, 2013-14; difficulty of taking it sledging, except in small quantities, 2015; it might have been taken instead of sugar, 2016; it is essential on board ship in absence of fresh vegetables, 2081; does not fortify men against future invasions of scurvy, 2082-3; to what extent a double allowance gives immunity, 2084-5; it should be sent sledging, 2092; effect of freezing lime juice, 2115; objection to mixing it with tea, being unpalatable, 2162-3; if sent, the scurvy would have been delayed, or modified, 2166-8; not averted, 2167.

6. Medical Instructions and Appliances—

Furnished instructions to the officers, 1616, 2128-9; sledge party provided with medical appliances and instructions, 2051; instructions framed by himself, 2052; what

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means he took for making them out, 2052, 2135; petty officers taught the use of medicines and appliances, 2052, 2135; no mention of scurvy in them, 2053, 2131; reasons for this, the instructions given them only contemplated slight ordinary cases, 2054, 2132; he acted up to his instructions from the Medical Director-General in issuing them, 2134, 2175; was aware of Medical Director-General's memorandum, 2174; submitted them to Captain Nares, 2136; who made no correction, 2137-8; told Captain Markham, in case of scurvy, to give onion powder and potato, 2139; and described certain symptoms, 2140.

7. Scurvy, Cases of (Treatment by Lime Juice, *see* Lime Juice)—

Was always on the watch for scurvy, 1832; especially in such cases, 1835; scorbutic symptoms appeared in Petersen in April, 1691-3, 1704; was not surprised under the circumstances, 1705; illness of George Kemish, ward-room steward, 1710; beginning in January, 1712; suffered from debility, induced by drinking, 1713-14, 1727-8; his symptoms, how far scorbutic, 1715-27.

Illness of George Burroughs, ship's steward, 1795, 1844, 1868; not at first scurvy, 1796; had been examined monthly and found healthy, 1799, 1800, 1812; medical history satisfactory, 1810-11; did not sledge, 1799; to what extent he may have been addicted to spirits, 1803-8; was of good character and honest, 1802; scurvy broke out 1st May after some time of confinement to ship, 1815-19; his treatment and medical diet, 1820-23, 1836, 1843; when suspected of scurvy and put on extra ration of lime juice, 1830; his symptoms, 1837; inability to take exercise on board, 1842; his recovery, 1844.

Case of Berrie, sent back very soon from sledge for debility, 1845; appeared well at first, 1846; to what extent he had scurvy, 1852; was discharged to light duty though not cured, 1853; necessity of doing so, further development of disease, his recovery, 1853-4.

Case of V. Dominique, 9th April, on return from sledging, 1855-7.

Case of John Simmons, who had been dog-sledging, 1858-60.

David Deuchars, ice quartermaster, after two short journeys, 1861-7.

John Thors, ice quartermaster, after two short journeys, 1870-78; was not ill during his expeditions, 1874.

Benjamin Wyatt, of "Discovery," on return from his own ship, 1879-84.

James Cane, armourer, who had been a short journey, 1885-91; not taken ill on the journey, 1887; not sent on an extended journey on account of doctor's advice, 1892-4.

William Lorimer, A.B., brought back, after accompanying Lieut. Giffard, 1895-9.

William Wolley, a similar case, 1900-3.

Out of 39 cases, only one (Burroughs) did not sledge, 1997-9.

Frederick, the Esquimaux, 1904-9.

Robert Symonds, who had been with Lieut. Giffard, 1910-13.

Thomas Smith, R.N., after several short journeys, 1915-21.

Thomas Chalkley, A.B. of "Discovery," after several short journeys, 1922-5; taken ill when travelling, 1926.

Daniel Girard, A.B. of "Discovery," after sledging, 1928-34.

Fourteen cases from northern sledging party, 1935-48; all recovered, 1948.

William Ellard, marine, had been with Lieut. Giffard, and with relief party, 1949-56; became ill after having returned three days, 1953.

Seven cases from Lieut. Aldrich's party, all recovered, 1957-69; some milder than others, 1960; all taken ill travelling, 1964; all recovered, 1969.

Lieut. Aldrich examined and found well, 1968.

Thomas Stuckberry, after journeys with Lieut. Giffard, and a relief party, 1970-80; became ill after being on board a few days, 1975; probably had symptoms while travelling, 1978.

Thirty-nine cases under his care, three men belonged to "Discovery," 1983-5; all recovered, one man died before coming under his care, 1987.

Description of the treatment, chiefly dietetic, 1989-90; men sent on deck when weather got better, 1992; a good temperature kept up in steerage, and disinfectants used, 1992; advantage of fresh food and lime juice, 1992; remarkably beneficial effect of fresh meat, 2184; the amount he was able to give, 2185; preserved provisions given, 2186; allowance of potatoes doubled in treatment, 1995; description of the symptoms, 2059-69; no experiments made on the blood, 2069.

Condition of Adam Ayles, an abstainer, on return to ship, 2120; comparative immunity due to temperate habits and vigorous frame, 2122.

8. Scurvy, Causes of, and General Opinion—

Was always on the watch for it, 1831-2; debility not always an early sign of it, 1847; pain in the legs and stiffness the earliest symptoms of men who have been sledging,

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1849; the remote causes absence of fresh vegetable food and fresh meat, 2000; the predisposing causes, long absence of, sunlight, damp, and cold, 2000, 2077-8; exciting cause the physical exertion of sledging, 2000; definition of these terms, 2004-6; predisposing causes weakened the men, but had no obvious effect, 2001-3; how far physical exertion was an exciting cause in the ship's steward, 2007-11; difference in sledge diet and absence of lime juice may account for it, 2012-14; symptoms developed in proportion to absence sledging, 2057, 2125; the hard work influenced the severity of the symptoms, 2058, 2125; to what extent darkness predisposed them to sickness, 2077, 2144-5; prolonged absence from vegetable juices the essential cause, 2080; is not a disease of incubation, but there may be gradual depravation of blood, 2086; the Danish Esquimaux suffer from scurvy, 2103-4; greater predominance of the disease possible at certain times, owing to greater cold, 2107; comparative immunity of "Discovery" due to less sledging, 2108; and larger supply of fresh meat, 2110.

9. Hygiene and Ventilation of Ship—

No complaint made of cubic space in "Discovery," 2111; not entirely satisfied with heating, or ventilation in "Alert," 2172; except the quartermaster of the watch, all the men were below at night, 2183; whether satisfied with hygienic condition of the ship, 1635-6; usual allowance of cubic space given for men to sleep in, 1637; the lower deck extended further aft, 1637; the cubic space sufficient in his opinion, and the hygiene as good as could be under the circumstances, 1640; ventilation and warming pushed to extreme compatible with external cold, 2048; the air tested by Dr. Moss, 1641; the amount of carbonic acid found, 1642, 1648, 2178; had reference to the living accommodation, 1649; at what time taken, 2178-81; how far this amount would prove detrimental to health, 1643-4; result of testing the air outside, 1646, 2182; account of the ventilation established, 1650; perfect in the way of cleaning the deck, 1650; difficulty in admitting external air owing to cold, 1650; no means of heating air on admission, 1651; advantage of doing so, 1652-7; they had sufficient air between decks, 1653; suffered from moisture, 1654; due to vapour given off by men, 1655; amount that can be given off, 1656; fresh air required to hold this in solution, 1658; no inconvenience caused by the moisture, 1659; method of treating excrementitious matter, 1660-62; no smell on the upper deck, 1663; hygienic condition of the sick room, 1843.

COPPINGER, RICHARD W., M.D., Staff-Surgeon R.N.

Subheads 1. General.

2. Diet.
3. Diet, Sledging.
4. Health and Medical Subjects.
5. Lime Juice.
6. Sledging.
7. Scurvy, General, and Causes of.
8. Scurvy, Cases of.
9. Ventilation and Hygiene.

Reference to—

Lieut. Rawson—

Expedition to relieve Lieut. Beaumont, 1094.

1. General—

Service in the "Discovery," 2742-3; fifty-two persons wintered in her, 2754; acclimatisation, does not believe in, 2971; how far satisfied with equipment of the ship, 2981; information to be furnished to Committee, 2992.

2. Diet—

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3. Diet, Sledging—

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5. Lime Juice—

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7. Scurvy, General, and Causes of—

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8. Scurvy, Cases of—

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DE CHAUMONT, FRANCIS S. B. F., M.D., Surgeon-Major.

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2. Diet on Board.
3. Diet, Sledging.
4. Lime Juice and Acids.
5. Sledging; amount of work done.
6. Scurvy.
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Estimate (as approximate as possible in absence of positive data) of the work done by the northern (Markham's) party, compared with the productive force of the food, 5006; the weight dragged being 236½ lbs., on the assumption of the weight of a man in his clothing being 200 lbs.; the work, exclusive of road-making, 5006; this maximum being on the assumption of the food being thoroughly digested and dealt with to the best advantage, 5007; the men were worked up to their total capacity and the total productive power of their food, 5008, 5015; similar estimate on the western (Aldrich's) party, on the basis of 241 lbs. dragging weight, and 200 lbs. per man and clothing, 5008; apparently more (though probably not so) than in Markham's journey, 5008-9; the roughness of the northern road, and the consequently sudden pulls more exhausting, 5010; the diminution in weight with the progress of the journey counterbalanced by the loss of effective dragging power from sickness, 5011-14; there are instances in this country of work being done up to 700 foot-tons, 5021.

6. Scurvy—

Instances in the Crimean war among British troops, 4961-9; arising with deficiency of fresh vegetable food and issue of salt meat, 4961-2; greater sufferings of the French who had little fresh meat, and for vegetables, chiefly rice, 4963-6; use of dandelions to make soup, 4964; recurrence of the disease when dandelions failed in bot weather, 4968-9; the disease originated in Bulgaria, checked by grapes and vegetables procured in the Crimea, 4965; instance in Scotland with men living upon porridge, or tea and bread without succulent vegetable, 4970; their recovery on a diet of milk, broth with vegetables and potatoes, 4970-71; no great difference in the symptoms, but in the Crimea it produced dysentery, 4973-4; instance of scurvy with a plentiful diet of bread and meat only, recovery on diet of vegetables and lime juice, 5134; the causes of scurvy principally want of constituents found in fresh vegetables, 4976-7; or absence of vegetable acids, 4978, 5080; possibility of want of albuminous food, and other errors in diet causing it, 4976; darkness, cold, privation, damp and fatigue predisposing causes, but not capable of producing scurvy without absence of fresh vegetable material, 4994-5; depression of mind and monotony of life aiding causes, 5082; also moisture in the atmosphere, 5085; great as the amount of work was in the recent sledging expeditions, it would not produce scurvy with antiscorbutic food, 5019; work has been done under similar conditions with immunity, 5020; and more work without scurvy, 5021; in the recent sledging expeditions, scurvy appeared earliest in Markham's party, 5010; it was not recognised for some time, 5022; considers it odd that surprise should have

DE CHAUMONT, FRANCIS S. B. F., *continued*—

been felt at its appearance under the circumstances, 5023; it was due to want of antiscorbutics when sledging, 5023, 5063: helped by excessive work and prolonged darkness, 5063; difficulty in explaining the occurrence of a case within fourteen days of leaving the ship, 5049; probably due to loss of lime juice and other antiscorbutics, 5049; other predisposing circumstances may have existed, 5050-51; the long absence of light would predispose men to it, and produce anæmia, but not of itself scurvy, 5052-3; and the foul air and length of darkness were principal predisposing causes, also the extreme cold, 5081; but foul air would not of itself produce scurvy, 5078, 5125-7; but would reduce physical health, and the standard of health, 5127; precautions against scurvy are, proper cubic space of air, 5083; and renewal of air, 5089-90; a dry atmosphere, 5084; abundance of vegetable food, 5086; cheerful habits and fair exercise, 5087-8; these should keep men through the winter fit for severe work, 5089; difficulty in accounting for immunity of other expeditions under similar conditions, 5124; in the case of the "Polaris" party on the ice floe, fresh meat would have acted as antiscorbutic, and made up to some extent for want of vegetable diet, 5130-2; absence of fatigue another cause of immunity, 5131.

7. Ventilation—

3000 cubic feet and upwards required in dormitories per man per hour to maintain the standard of purity, 5027, 5064, 5093; 5000 if in active employment, 5027; renewal necessary, three to four times an hour the most practicable at the ordinary temperature, 5028-31; impossibility of renewing it twenty-five times as necessary for arctic ships with a low temperature, 5032-3, 5065; possibility if heating removed the difference between incoming and outgoing air, 5034-6; air outside frequently renewed as often, 5044; through an aperture of 24 square inches, to effect the renewal, the air must travel at 3.4 miles hour, 5067-70; the draught would be too great unless the air were heated, 5070; an extraction apparatus the best way of ventilation, 5071-2; arctic ships might be equipped with one if the air could be heated, 5073; .4 or .5 per cent. carbonic acid in the air extremely impure, 5038; half a volume per thousand the maximum permissible, 5039; the analysis of outside air made on the top of mountains and in London streets showed about the same amount, .4 per thousand, 5041-2; by heating air before admission, the condensation would be removed; capacity for vapour increasing with the temperature, 5043-4; calculates the inmates of the arctic ships to have had only 160 cubic feet per hour, 5044; 600 cubic feet space net allowed to each man in barracks, 5045; 1200 in hospitals in temperate climates, 5046; the renewal takes place twice an hour, 5047; it is done without inconvenience, but some of the air is heated, 5048; air can be renewed three times an hour without discomfort with 1000 feet per man, 5096; importance of renewal of air in maintenance of health, 5089; the difference in living spaces disappears after two hours, 5090-92; unless the space is practically open-air, 5092; an open window or a ventilator necessary in every room, 5093-4; fresh air acts as antiscorbutic by providing the blood with oxygen and preventing breathing impure matter, 5098; amount of carbonic acid shown in estimations of "Alert" proves the impurity of the air, 5119; fresh air admitted only one-tenth of the requisite amount, 5119; the estimations show it was not accounted for by excess of carbonic acid in external air, 5121.

DICKSON, WALTER, M.D., Staff-Surgeon, R.N.

Subheads 1. General.

2. Diet on Board.

3. Sledge Diet.

4. Lime Juice.

5. Scurvy.

6. Ventilation.

1. General—

Medical Inspecting Officer of the Customs, 5616; the age for arctic service should be from twenty-five to thirty-five, 5635, 5699; the young and old men more susceptible to scurvy than the middle aged, 5700-1; his experience as medical officer in charge of the "Pagoda" in the antarctics from December to April, 1844-5, number and size of icebergs, 5673; thermometer seldom below +20, 5675.

2. Diet—

The rate of victualling in late expedition good, 5661; and quite sufficient, 5664; the quantity of pork might have been increased, 5662; pork is much relished by seamen, and very nutritious; it should be issued with preserved meat, 5662; comparative immunity of the "Discovery" due to fresh meat, which, though an antiscorbutic, maintains the standard of health, 5695-6; preserved potatoes not equal to fresh, but cooked are equal to raw, 5714, 5729; molasses an antiscorbutic and good with pork, 5715-16; but molasses and potatoes not better than lime juice, 5716; recommends preserved milk for the dietary, 5718; but does not attribute antiscorbutic virtue to it, 5717;

DICKSON, WALTER, *continued*—

cranberries and tamarinds good antiscorbutics, 5719-20; but not better than lime juice, which keeps better, 5720; valuable properties of unripe apples, 5722; diet in his voyage to the antarctics, preserved vegetables and meats, and dried fruits, 5676, 5720; dietary recommended for the merchant service, 5663.

3. Sledge Diet—

The rations mostly sufficient and well selected, but the antiscorbutics insufficient, 5622; men living on it would be subject to scurvy, 5623; lime juice might have been substituted for rum or tobacco, 5625; would have taken some rum and mixed it with lime juice, 5626; rum is desirable, but lime juice of greater advantage, 5684; would sacrifice rum rather than tea, but considers it a desirable addition, as producing cheerfulness, 5722.

4. Lime Juice—

Lime juice should have been taken sledging, 5622-24, 5707; instead of rum or tobacco, 5625; being more essential, 5684-5; it might have been concentrated into a denser form, 5626, 5704; or mixed with rum, 5626, 5680; the mixture would be palatable, 5682; and would partly prevent freezing, 5683-4; doubt about concentrating it into a solid form without losing its properties, 5704; but it would be valuable in the form of a lozenge if possible, 5705-6; it is essential as an antiscorbutic in the absence of fresh vegetables, 5631; lemon juice made by wholesale confectioners in London, 5632; lime juice imported from West Indies, 5632; lime juice more grateful, but little difference in their dietetic properties, which depend on the state of the fruit when picked, 5633; the ripe lemons having less property, 5722; citric acid alone not antiscorbutic, instances of occurrence of scurvy where it has been given, 5634; one ounce of lime juice was a sufficient ration in the late expedition, 5665; it is the required ration in the merchant service, 5666; wording of the Act of Parliament enforcing its issue, 5667; importance of a daily issue, 5667; improvement in the merchant navy since the Act of 1867 compelling its issue, 5668-9, 5670-1; citric acid used to be sent as saving bulk and not spoiling, but the results were disastrous, 5687; though the acid was citric, 5688; no trace of citric acid found in some bad lime juice, 5688; lime juice easily tested without chemistry, 5690; the acid is the important element in lime juice, but in inseparable combination with other matters, 5691-2; possibility of abstraction of water from it, 5693; lime juice was regularly used in his voyage to the antarctics, 5677; one ounce a day a double ration, 5678; the same amount should be taken sledging as on board, 5707-10; an ounce a day adequate, 5709; amount of citric acid in the merchant navy lime juice superior to some of the navy, 5722; administration of lime juice in the recent sledging parties would have delayed and mitigated the scurvy, 5727-8; but not averted it altogether, as it is only a substitute, 5728.

5. Scurvy—

The immediate cause in the recent expedition the want of vegetable food or lime juice, 5619; absence of light, comparatively unwonted diet, cold and inaction, predisposed the men to it, and cold and discomfort sledging developed it, 5620-21; but could not by themselves have resulted in it, 5659; the hard work hauling sledges had much to do with it, 5697; the greater immunity of the officers due to being better fed and lodged, and probably less exertion when sledging, 5694; possibly to more attention to ablutions, 5696; and to their more intellectual amusements, 5697; or influence of higher education, 5698; greater immunity of "Discovery" due to fresh meat, 5695; over-exertion tends to develop it, 5711; darkness depresses the vitality, 5712; the inquiries in merchant ships he used to make for the Board of Trade, 5627; the disease seldom broke out before the ship had left its port sixty days, 5629; the ships chiefly came from hot countries, 5628; vitiated air not the cause of scurvy, 5652; which is purely a disease of defective nutrition, by privation of fresh vegetables, 5654-5, 5724; a blood disease, 5724; privation in nitrogenous or albuminous food do not cause it, 5656; personal cleanliness much to do with it, 5696; cold, fatigue, malaria, and syphilis may aggravate, but cannot produce it, 5725; fresh vegetables and fruits can alone prevent and cure it, 5726; no scurvy in his voyage to the antarctics, 5674-9; immunity from scurvy of "Polaris" party possibly due to seal meat, 5702-3.

6. Ventilation—

The cubic space enforced in the mercantile marine by Act of Parliament, only 72 feet, 5636-8; this would be doubled by half the crew being on watch, 5638; cubic space unimportant with plenty of apertures, 5638-9; the difficulty of renewing the air in arctic greater than in temperate climates, owing to cold, 5641-2; advantage of admitting heated air, 5644-6; vitiated air reduces the standard of health and causes diseases, but not scurvy, 5647-51.

EDE, CHARLES, formerly of H.M.S. "Assistance."

Subheads 1. General.

2. Diet on Board.
3. Diet, Sledging.
4. Lime Juice.
5. Sledging.
6. Scurvy, Health.
7. Ventilation.

1. General—

Service as assistant surgeon of "Assistance" (1850-51), 4040-41; men accustomed to the climate stand its rigors better, with a good dietary, 4105; from 25 to 30 the best age for men, 4106-7.

2. Diet on Board—

Diet of "Assistance" sufficient to maintain health, 4043; difference between it and "Alert's," "Assistance" had chocolate with milk, and sugar beer, 4045-6; sugar beer antiscorbutic, 4046; found scurvy-grass and sorrel at the Carey Islands, 4109; grew a little mustard and cress, 4110; found it beneficial, 4112; preference for raw over Edwards's potato, 4125; Americans ate it raw as a salad, and found it beneficial, 4125; quantities of eggs obtained, 4127-30; value of eggs as antiscorbutics, 4127; advantage of adding them to the diet, 4195; suggestion to preserve them with boiling vinegar poured over them after removal of the shells, 4195-9; ordinary eggs would not taste as nice after being kept some time, 4200; recommends addition to diet of recent expedition of condensed milk, tamarinds, butter and cheese, 4253; molasses used as an antiscorbutic on board De Haven's ships, 4242.

3. Diet, Sledging—

In sledge journeys in autumn, pemmican, pork, and chocolate and milk, 4066; the diet in spring (similar, with biscuit and tea), 4069; preference for tea over rum, 4100; the reaction from excitement of the rum produces too much depression, 4101; a little rum should be used as a filip before the evening meal, 4102-3; tea should be given at midday when undergoing exertion, 4104; what game they found on their journeys, 4108; his dietary similar to that of "Alert," but had no stearine or onion and curry powder, and less potato, 4144-6; arrangements for cooking, 4180; potato the only vegetable, 4181-4; it or biscuit crumbs mixed with the pemmican, 4183; did not obtain Greenland cress, 4185; used saxifrage with pemmican on a seven days' shooting expedition, 4186-8; condensed milk is highly desirable, 4190-91; it must be antiscorbutic, as it contains all the elements of life, 4192-4; in proper proportion of different constituents, 4194; difficulty in thawing water and making tea, 4246; would add lime juice and preserved milk to dietary of recent expedition, 4254.

4. Lime Juice—

Was taken regularly in "Assistance," 4047; taken by the men at the tub, 4048; no one refused to drink it, 4049, 4081; was taken with satisfaction, 4082; lime juice not taken in autumn sledging, 4066, 4143; was taken in spring, no difficulty in carriage, 4070-71, 4083; one bottle broke from frost, but it was carried all the same, 4072; quarter of an ounce given, 4073, 4148; in the evening before the food, 4073-6; it was eaten when frozen, 4076-7; has eaten it so, 4076, 4123; did not thaw it, 4084, 4150; broke the neck of the bottle to get it out, 4151; did not notice any difference in its ingredients in any part of the bottle, 4152-3; it was a friable mass, 4154; easily issued, 4156; was roughly measured, 4156; was taken without dilution, 4159; no bad effects followed, 4161-4; lime juice may or may not be diluted, 4166; was generally diluted, being more agreeable, 4167-8; it would not produce mucous irritation in healthy people, 4170; addition of sugar increases its antiscorbutic properties, being nourishing, 4241; prefers taking it liquid, with water, 4243-4; its great value as an antiscorbutic, 4249; it is a necessary article of sledge diet in absence of fresh vegetables, 4250; it was good and efficacious, assuaged thirst, and was much prized, 4079-80, 4165; it was taken in quart bottles, 4086; about eight gallons the ration for nine men for eighty days, 4085-9; it is a powerful antiscorbutic, 4090; scurvy in recent expedition would have been modified if taken and previously drunk on board, 4091; no deterioration of lime juice in the arctic, 4093; it should be carried sledging, 4121; want of fuel no insuperable difficulty, 4122.

5. Sledging—

Enumeration of sledge journeys, 4042; officers did not drag, except when difficulties arose, 4098; his journeys, they were with man-sledges, 4131-41; dragged 187 lbs. at starting, but weight diminished, 4135-6; what the temperature was, 4137, 4247; the snow in the autumn soft, in the spring hard, 4234; not deep on the floe, but was in ravines, 4235; travelled by night, 4248; the ice was rough and hummocky, 4260; snow soft after a fresh fall; sank quite a foot in it, 4261; in the recent expedition, the ice was more difficult than in his case, 4262; and the snow more uniformly deep in the land journeys, 4262.

EDE, CHARLES, *continued*—

6. Scurvy, Health—

Health of men in autumn journeys very good before starting, 4064; and on return, 4067-8; had no traces of scurvy, 4065; no scurvy in his sledging party, 4095; nor scorbutic symptoms, 4263; treated men for frost-bites and snow blindness, 4096-7; brought back some cases of frost-bitten and snow-blind men from other sledges, 4171; they had no scorbutic symptoms, 4172-9; nature of snow blindness, 4251; treatment, 4252; the crews in very good health on their return, 4113; could have stood another winter, 4114-15; reasons for immunity from scurvy, lime juice, ventilation, exercise, and eggs they obtained, 4127; cannot express an opinion upon the causes of the recent outbreak, 4258-9; has heard of scurvy among semi-civilised Esquimaux, 4117-20; instance of scurvy in the Pacific in a frigate, though taking lime juice, after six or eight months diet on salt meat, 4124, 4201-20; fifty men ill, and the whole crew debilitated, the provisions bad, two ounces lime juice served out every day, preserved potato used, the temperature over temperate, recovery after obtaining bananas and melons at Honolulu, and fresh meat and fish, 4201-20; instance he treated of agricultural labourers, of about twenty, who had had a full diet of pork, bread, and beer, cured by a lemon a day, 4224-33; absence of light injurious to the constitution, 4255; his men looked blanched after the arctic night, showing deficiency of red blood, 4256; the pallor disappeared after the return of the sun, 4257.

7. Ventilation—

"Assistance" warmed by Sylvester stove, 4050; passing through the cabin, 4051; whether the hot air escaped and was renewed by fresh air, 4052-4; ventilation was by it, and opening of hatchways, 4055; had downtakes, 4056; no uptakes, or tanks over hatchways, 4057-8; the air tolerably pure, the lower deck emptied by sending men out, 4059; not much drip, 4060; condensation troublesome, but not very, 4236; ventilation better than in "Resolute," 4062; having more height between decks, 4063; the moisture was driven off by the Sylvester stove, 4237; no difficulty in ventilation in the frigate in which he saw scurvy, 4222-3.

EGERTON, GEORGE Le C., Lieutenant, R.N.

Subheads 1. General.

2. Lime Juice.
3. Sledging.
4. Scurvy.

Reference to—

Commander Beaumont—

Journey to "Discovery" in March, 1042.

1. General—

Service in the "Alert," 1527-8.

2. Lime Juice—

Used an ounce of lime juice daily per man on inland trip, 1558-60, 1595; it was regularly taken by the Esquimaux who had scurvy, 1564, 1593; taken by Esquimaux from day of starting, 1594; did not take it till May, when it did not freeze, 1570; when and how it was given, 1596-7.

3. Sledging—

Enumeration of the journeys he performed, 1529, 1571; his journey to the "Discovery," in March, 1530; to Greenland, 1531-4; exploring journeys inland to foot of United States Mountains, 1535-7; by whom accompanied inland, 1548, 1579; his journeys very short, their length, 1572-6; what sledges he commanded, and when (the dog-sledge or others), 1538-41; travelling to Repulse Harbour, better than to "Discovery," 1542; difficulty in going to "Discovery," the nature of the travelling, 1543; what amount of ice-foot there was, 1544-5; difficulty in inland journey owing to deep snow, 1546, 1550; the sledge drawn by dogs, 1581; the dogs could not get through the snow, 1551; fell in with some lakes, 1553; the Esquimaux drove, 1582; preference for travelling over hummocks with a light sledge than in deep snow, 1547; sledge equipment satisfactory, 1567; cooking apparatus cooked too slowly, 1567-8; made a few small improvements, 1569; driving the dog-sledge hard work, 1584; the ordinary Canadian snow shoes would have been of great service inland, 1610-12.

4. Scurvy—

Had no medical instructions for scurvy when sledging, 1561-2; only one case, the Esquimaux Frederic, 1563; his was not a severe case, 1566; it occurred in expedition to Grinnell Land, 1577; he had not hard work, 1583; had been sledging before, 1585; he had wintered in "Alert," and been healthy, 1586-7; did not suffer cold, 1589; was clad as the others, 1590; his symptoms, 1598-1602; he was never a strong man, 1599; continued work nearly the whole time, put on the sledge in hard travelling, 1603; had not recovered on return, 1605; remedies applied, 1606; no idea of its being scurvy, 1607; he took his spirits, but not particularly fond of them, 1609.

EMMERSON, GEORGE W., Boatswain, R.N.

Subheads 1. General.

2. Diet on Board.
3. Diet, Sledging.
4. Lime Juice.
5. Scurvy and Health.
6. Sledging.
7. Ventilation.

1. General—

Service as chief boatswain's mate in "Discovery," 8081-3; was caterer to a mess, 8085; had charge of men in regard to duties, 8241; could not have got a better class of men, 8182-3.

2. Diet on board—

The salt beef and pork bad, 8100-1; has never had such bad salt provisions, 8104, 8202-3; used to make the preserved meat last two days rather than take up salt meat, 8104, 8209; which amounted to half rations one day a week, 8210-11; the other provisions good, 8102, 8167, 8329; except the collops, 8168, 8225; the allowance was more than they could eat, 8222; the objection to the salt beef was on account of hardness and saltiness, 8189-90; why not complained of before "Valorous" left, 8191-2; it was not taken up or eaten and therefore could do no harm, 8194-98, 8207; the issue of salt meat stopped, owing to objection to it, 8104, 8212; when this was done, 8204-5; preserved meat was issued instead of it, 8213; a good deal of musk ox obtained, 8105, 8281-2; issued twice a week, 8277-8; the old oxen tasted too strong and tough to be liked, 8106, 8287, 8345-6; the young nice, but lean, 8287; musk-ox days looked forward to, 8341; every part eaten, 8342; the liver and kidneys sweet, 8343; reasons for objecting to the collops, no substance in them, 8169-71; many puddings cooked, 8172; what issues for them were made, 8175; plenty of flour issued, it was liked, 8173-4-6; compressed vegetables not cared about, 8184; preserved vegetables liked in soup, 8185; chocolate drunk, but tea preferred, 8186; preserved milk distributed from ward-room during return, 8187-8; the pork was nice, but fishy, 8199, 8203, 8217, 8330; it was issued once a week throughout the winter, 8214-15; only about half the men took it up, the rest left most of it behind, 8214, 8217-24, 8331; objecting to it as fishy, 8332-3; the meat taken up and cooked was divided among all the messes, and sometimes eaten cold, 8224; no savings were paid, 8223; the ox-check was good, 8226-28; the minced collops were not liked, 8168, 8225; the half-rations issued with other preserved meat were not eaten, 8229-34; the captain altered the diet in consequence, 8233-5; the alteration being made directly matters were represented, 8334-5; the want of food not felt, in spite of not eating all the food, 8236-8; preserved potatoes issued thrice a week, and were popular, 8267-8; he had them by saving every day, 8265-6; what amount of game they had, exclusive of musk ox, 8269-77, 8284-6; fresh mutton issued on Christmas day, 8283; personally does not care for preserved meat, but lived on it and fresh meat, 8337-40; seldom touching the salt meat, 8340.

3. Diet, Sledging—

Objects to rum whilst travelling and prefers tea, 8177; rum is useful when in the sleeping bag, by giving a glow and inducing sleep, 8177-9; especially if taken in tea, 8179; tea twice a day, 8180; diet sledging in the autumn, 8289-90; the same rations taken as in spring, 8291-3; the spring ration more than they could eat, 8296; but could have eaten more biscuit, 8297-8, 8301; the pemmican heavy feeding; could not eat it all, 8299, 8300; had as much potato as they could eat, but less than on board, 8302-5.

4. Lime Juice—

General liking for it, 8107; it was always drunk, 8107; and was looked forward to, 8362-3; did not carry any sledging in autumn or spring, 8130, 8295; or get any at Polaris Bay, 8131, 8308-9; the men of his sledge had lime juice when on board "Alert," 8144; were about twenty-six days without it, 8145; Shepherd mixed the lime juice, 8161; and took his fair quantity regularly, 8162, 8260.

In the Merchant Service—

It was given every day fourteen days after leaving England till Calcutta, 8349-52; was not given in ships on Baltic trade, 8353-4; but fresh vegetables were carried, 8355; is taken readily as a pleasant beverage, 8359-61.

5. Scurvy and Health—

Piles produced by wetness from condensation on the carpet on the lockers, 8087; stiffness of leg of some men in journey from "Alert" to "Discovery," but it wore off, 8109; the crew in good health at the end of the winter, 8108; they were fit for sledge travelling when the sun returned, 8327-8; two of his sledge crew attacked with scurvy, 8132; but were not disabled whilst travelling, 8133-4; of the four men of his sledge who had been twenty-six days without lime juice two had scurvy, and perhaps a third, 8149-50, 8312; was exempt himself, but was attacked when on shore in England, 8150-52, 8316; a week after being on leave, 8153; treated himself with

EMMERSON, GEORGE W., continued—

vegetables and good living, 8151; his symptoms, 8316-18; suffered also from cough whilst in the arctics, 8323-24; there was very little talk on the lower deck about scurvy, 8154, 8364; thinks it due to hard work and want of vegetables and blood meat when sledging, 8366-68; does not attribute the outbreak to damp, 8163; case of Shepherd in the winter, 8155-60, 8259; soon after Christmas, 8242-3; the doctor did not allow the nature of the illness to be known, 8155-9; he was captain of the hold and ship's cooper, 8240; was not strong for sledging in the autumn, 8245-6; had drunk much malt liquor in his time, but did not take too much on board, 8248-9, 8254-5; used to work on the ice, 8252; had not a specially good appetite, 8256-8; was particular about food, could not eat it always, 8261-2; did not eat when ill, 8263; took vegetables, especially onions, 8264-5; the men did not suffer from the wet beds, 8326.

6. Sledging—

Was captain of Lieutenant Beaumont's sledge, and then in charge of one, 8084; enumeration of his sledge journeys, 8086; journey from "Discovery" to "Alert," 8111-12; weight not over 200 lbs. a man, 8110; journeys to Greenland and back to "Alert," and thence to Repulse Harbour, 8114-19; weights about 240 lbs., 8115-20; unloaded his sledge on one occasion in crossing Robeson's Strait, 8121; double manned a part of the way on Lieutenant Beaumont's Greenland journey, 8122-4; journey to Repulse Bay and thence to Polaris Bay, 8125-9; to what extent the crew of his sledge was changed, 8135-9; on return to "Discovery," men had been travelling about forty days, 8142.

7. Ventilation—

They had everything they could wish for, 8087; but the lower deck was very damp in the winter, 8165; but the carpet on the lockers was always wet from condensation, 8087; plenty of room on the lower deck, as much as usual in the navy, 8088-9; the berthing for hammocks was as usual, 8090; sat upon their clothes lockers, 8091; no ventilation under them, 8092-3; to what extent the bedding was wet from drip and frozen, 8095, 8325; hammocks were stowed in the main hold to prevent the bedding freezing, 8095-6; in unpainted hammocks the same freezing took place, 8096; uptakes put in different places, 8097; everything tried, but nothing stopped the condensation, 8098; formation of ice in the house over the hatchway, 8099.

FEILDEN, HENRY W., Captain, R.A.

Subheads 1. General.

2. Diet.
3. Diet, Sledging.
4. Lime Juice.
5. Sledging.
6. Scurvy.
7. Ventilation.

Paper handed in by—

Antiscorbutic plants in the arctic regions ..

No. in
Appendix.
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1. General—

Served in "Alert" as Naturalist, 5919; was one of the oldest men in the ship, 5967; men of 27 or 28 better than of 40, 5967; the ages of the men employed were a proper standard, 5971; officers may be older, experience being necessary, 5969.

2. Diet—

Difference between diet of officers and men; wine, sardines, jams, and potted meat, 5928, 6032; cheese, and butter, 6032; one member of the mess had some cranberries, 6034; port and sherry, with a little champagne, were the wines, 6035-6; the men had not good appetites during the winter, and could not eat their preserved meat, 5929-30; there was ample food, 5930; sauces would have improved their appetites, 5931; the officers eat much better in the winter, when the moon was at or near the full, as they could take more exercise, 5931-5; their appetites not so good at the end of the dark season, 6026; a large quantity of mustard and cress might be produced on land in July with glass frames, 5974; it was grown on board on flannel and in boxes, 6070; not used as a ration, 6072; was perfectly satisfied with the diet, but heard it said the salt meat was tough, 6024; he liked it very well, 6078; the ration was reduced, 6025, 6078; and stopped when scurvy existed to a large extent, 6078; good drinking water obtained, 6047; diet with General Beauregard, had no lime juice but vegetables, 6080; potatoes and molasses, 6081-2; potatoes were not taken raw, 6083; *Angelica officinalis* not found north of the 78th parallel, 5977-8; it is used as a preserve and considered antiscorbutic, 5976; they got mountain-sorrel, but little scurvy-grass, 6072; no cranberries, 6073; a little dandelion (*taraxacum dens leonis*) found between lat. 82° and 83°, 6074; it could not have been cultivated from want of seed, 6075-6.

3. Diet, Sledging—

Preference for tea over rum, 5961; it is best for travelling on, 5962; rum, if taken, is most useful before going to

FEILDEN, HENRY W., *continued*—

the bags, 5963; is disadvantageous when working, 5964; used pemmican, 6039; ate his own allowance and sometimes more, 6040; the potatoes were cooked mixed with it, 6041-4; the allowance of potatoes was very good, 6043; good drinking water obtained, 6046; advantage of plan taught by the Esquimaux how to eat snow (by sucking water out of it), 6065-7.

4. Lime Juice—

Took it regularly on board ship, and would have liked more; 5938-9; an ounce a day the ration, but doubled on return from sledging, 5949; little difficulty in obtaining more when returning south, 5949; it was taken by the men at the tub in presence of an officer, 5950; believes the extra issue to the messes was drunk, as the men liked it very much, 5951-2; it is a valuable antiscorbutic, 5955; question of its freezing in extended sledging, 5954; took lime juice sledging, except in April, when the temperature was low, 5937-41; and doubts whether it was not taken then, 5989-90; was able to take it, as it could be used without thawing, 5985, 5992; one ounce used, 5993-4; in what expedition he carried it, 5987; no obstacle to its use in May when sledging, 6019; took it after tenting, 6020; were thirsty, and glad to get it, 6020; thawed water for it in May, 6021; had an advantage over extended parties in taking it, economy of fuel was not so necessary, 6022-3; he took it as an antiscorbutic, and liked it also, 6068; considers it a valuable antiscorbutic, 6069.

5. Sledging—

Absent for about fifty days, but in short journeys, 5921, 5936, 5931-2; always had dog-sledges, 5983; hard work in July, dragging through slush, 5943-5; the officer in command had medical instructions, but no mention of scurvy, 5956; with the dog-sledges only one or two men went, 6045.

6. Scurvy—

Had some slight symptoms of scurvy in July, though lime juice was taken, 5942, 5997; attributes it to hard work (dragging whilst wading over the knees, 5945-6; he and Lieutenant Parr had a sledge between them, without men, 5958; did not last long after return to ship, 5947; enre attributable to rest and good diet, 5948; treated himself, 6001; had a double allowance of lime juice, 6002; symptoms very slight; hardly an attack, 5996; able to continue working; dragged a good load to the ship, 5996-6000; his symptoms, 5999, 6003; scurvy was not talked of during the winter months, 5957; the length of the absence of the sun may have had something to do with the outbreak, 5972-3; Frederick the Esquimaux suffered badly from scurvy in May, 5975, 5995; but stated he would get the "Qvan" at Disco as an antiscorbutic, 5976-80; he had it in April and again in May when sledging, 6005; had not been sledging before April, 6006; employed on regular ship work, 6008; was well on leaving in April, 6010; when lime juice was not carried, 6012; was not regularly on the sick list, 6009; it was a decided though not severe case, 6016-18; his symptoms, 6017, 6061; he merely managed the dogs when sledging, 6059-60; his symptoms appeared the day of leaving, 6062; he was not a great eater, 6064; none of the officers of the "Alert" on the sick list for scurvy, 6027; but several were suffering from slight symptoms, 6028-31; of whom the doctors knew nothing, 6030; no scurvy when with General Beaugard, 6084.

7. Ventilation—

The air of the ward-room of "Alert" wonderfully good, 5923; a good deal of condensation in remote corners of the ship, 5924; plenty of drip from the beams at night in his cabin, 5925; which he caught in a blanket over his head, 5926; condensation cannot be entirely prevented, 5927; where his cabin was, 6048; warmed by the ward-room stove, 6049; was generally above 32° in winter, 6050; anything just below freezing an advantage, there being less drip, 6056; the ventilation of it was good, 6051; arrangement for ventilating it by an indiarubber tube communicating with the open air, opening or closing at will, 6051-3; could thus get air in or exclude it, 6055; there was an uptake in the ward-room, which ventilated his cabin, 6057-8.

GIFFARD, GEORGE A., Lieutenant.

Subheads 1. General.

2. Diet (including Lime Juice).

3. Sledging.

4. Scurvy.

Paper handed in by—

Sledge party returns

No. in
Appendix.
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1. General—

Service in the "Alert," 1201-2; a few slight cases of snow-blindness, 1219; information he is to furnish, 1250; quite satisfied with equipment of "Alert," 1251.

2. Diet (including Lime Juice)—

Lime juice should be taken sledging, 1221-33; being a good antiscorbutic, 1223; took it on his second journey,

GIFFARD GEORGE A., *continued*—

1222; the sick men asked for it, 1224; supply of it to them, 1225; but did not improve, 1226; advocacy of use of spirits, 1229; after supper, 1230; advantage of tea, the men looked forward to it, 1232; the tea and spirits given separately, 1247; would not substitute lime juice for spirits, 1234; an ounce of lime juice the daily ration, 1235; the men did not care much for it, 1236; lime juice had been taken by the men before they fell ill, 1239; but they had been on previous journeys without it, 1246; suggestions for carrying lime juice, each day's allowance in a separate bottle, 1248.

3. Sledging—

Enumeration of sledge journeys he was engaged in, 1203-4; the snow was soft and deep; its depth, 1205-6; labour of dragging increased by it, 1206; had medical instructions and medicines, 1213; instructions furnished by the surgeon of the ship, 1216; what the lowest temperature was, 1217; the cold prevented sleep, 1218; the men slept well, as a rule, 1231; they did not suffer from thirst, 1237; would not diminish the length of the day's work, as performed by him, 1249.

4. Scurvy—

Two cases in last journey, 1207; their symptoms; one man left in a snow house, 1208-9; did not recognise the symptoms, 1211-12; what remedies he applied, 1215; lime juice taken by the men without avail, 1225-6; they ultimately recovered, 1227; one man ill the day of leaving, 1239; he was healthy, and had not undergone extra fatigue, 1240-41; what the causes of scurvy were, 1242; what amount existed among men who did not travel, 1244.

GUY, WILLIAM AUGUSTUS, M.D., F.R.C.P., F.R.S.

Subheads 1. General.

2. Diet, General.

3. Diet on board the Arctic Ships.

4. Diet, Sledging.

5. Lime Juice.

6. Scurvy.

7. Scurvy, instances of.

8. Ventilation.

Paper handed in by—

No. in
Appendix.

Comparison of convict with arctic dietaries .. 25

1. General—

Professor of Hygiene to King's College; Consulting Physician to King's College Hospital; and Vice-President of the Royal Society; has been President of the Statistical Society, 5308-9; and Medical Superintendent of Millbank Prison, 5310; studies of scurvy whilst chairman of committees on dietaries, 5313; the best age for arctic service, twenty-seven upwards, 5400-1; the constitution being more formed, 5402; importance of training before long sledge expeditions, 5410; men never yet exposed to such intense cold, wet, fatigue and privation as the recent sledge parties, especially in the northern expedition, 5410.

2. Diet, General—

Importance of potato in preventing scurvy, 5313-15; rice not equally good, 5314; prisoners never have fruit, 5315; or other vegetables than potato, except in soup, 5315; vegetables and fruits rank together as antiscorbutics, 5319; properly preserved vegetables rank next to them, 5319; arrangements made in drawing up a dietary for convict prisons, 5323; account of the dietary given to convicts at hard labour (containing 335 ounces of solid food a week), 5323; comparison between convict diet and that on board and sledging in the recent expedition, 5323, 5330; superiority of the convict diet in bread and potato, 5330-31; inferiority in meat, but the meat fresh, 5331; 168 ounces of bread given to convicts, and bread and cheese on Sunday, 5330; previous to the Committee on dietaries the prison dietaries varied, and some were in excess, 5332; fresh vegetables preferable to dry, but how much cannot be said, 5348, 5379; want of vegetables in former times in England, and a state of health thereby induced rendering disease more severe, 5361; the antiscorbutic property of the potato due to its vegetable acid, 5376; preserved potatoes not equal to fresh, but need not be much inferior, 5377; prisoners will go through almost anything to get a smoke of tobacco, 5415; in devising dietaries it is important to consider what people like, 5415; weights of men are not a really good test of the effects of dietary, 5415; faulty results arising from trusting too much to it, 5415; scientific data of quantities of gaseous constituents of food very unsound, 5415; instances of serious errors committed by relying too much on them, 5415.

3. Diet on Board the Arctic Ships—

Comparison of it with the diet of convicts at hard labour, 5323, 5330; contained 321 oz. per week, against 335 oz. for convicts at hard labour, 5323; and lime juice and vinegar and spirit against milk, 5323; its superiority in meat, but inferiority in potato, 5330; it may be regarded as an adequate diet, and equal to that of the convicts, assuming the work in point of severity to be nearly similar, 5324-5;

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does not consider the amount of water-free food of the diets important, 5328; as the real value of an article of food cannot be measured by its dry elements, 5329; thinks favourably of it, but would have increased the compressed and preserved vegetables, 5336-8; even sacrificing for that the meat, 5337.

4. Diet, Sledging—

Comparison between sledge and convict diet, 275 oz. of solid food in sledges, against 335 oz., 5323; superiority in meat, inferiority in bread and potato, 5331; only 14 oz. of preserved potato in it, 5330-31; the potato element very small, 5331; and decidedly defective, 5331, 5339, 5344, 5384; onion and curry powder do not go very far to make up for absence of other vegetables, 5331; the vegetable diet defective, 5340-43; especially considering the omission of lime juice, 5341-2; the total quantity of food low compared with the convict diet, 5344; scurvy was to be expected under it, sooner or later, 5345; would have increased the potatoes to a half pound, 5385; the sledge parties should have been dieted before starting on the sledge diet, 5414; tea, owing to warmth accompanying it, much preferable to alcohol, 5415; alcohol the finest narcotic possible; instance of its use in typhoid fever, 5415; and should be taken sledging, to be used with discretion, to induce sleep, 5415; advantage of tobacco as a comfort, 5415.

5. Lime Juice—

Lime juice an acknowledged antiscorbutic, 5319; one of the best, 5383; all its constituents more or less useful, but the vegetable acids the most important, 5320; the water no value, except as a solvent, 5321; the defect in the sledging dietary might have been partially, not fully, remedied by lime juice, 5346; lime juice is not a perfect substitute for vegetable food, 5347; it should have been taken sledging, 5388; the amount should have exceeded one ounce, 5391; the one-ounce daily ration on board ship should have been increased, 5392-3; possibility of concentrating lime juice, as shown by that frozen in Polaris Bay, 5394; advantage of carrying it in the form of a lozenge, if its essential parts are retained, 5396-9; many extracts obtained by evaporation in vacuo at low temperatures, without losing their properties, 5397; possibility of the properties of lime juice being preserved if so prepared, 5398.

6. Scurvy—

Occurrence of scurvy in gaols where men have refused, or been deprived of potatoes, 5313-14; his remarks referring to persons who have no other class of vegetable or antiscorbutics, 5313-15; absence of vegetables the real cause of scurvy, 5315-18; it is not to be anticipated, without absence of them or their substitute, 5317; all which impairs health tends to production of scurvy, but will not produce it, 5351; circumstances in the late expedition, confinement, dampness, bad air, and other conditions must have impaired the health of the men, 5351-2; cold, reduction in food, and wet, are not necessary antecedents to scurvy, 5355-6; these conditions would not produce it with a suitable dietary, 5353-8; though followed by other wasting maladies, 5358; the disease is the same in warm and temperate climates, 5363; the symptoms may vary, 5364; vitiation of air would predispose to, but not excite scurvy, 5371; under the conditions of the recent sledging, no dietary or antiscorbutics that could have been carried would have prevented it, though it might have been postponed, 5410-12; the antiscorbutics carried in the ship did prevent the disease on board, except in one instance, proving the advantage of the diet, 5413.

7. Scurvy, Instances and History of—

Instance of the outbreak at Millbank in 1823, 5333; diet reduced from 304 to 168 ounces of solid food a-week, potato eliminated, meat and vegetables almost entirely removed, it was followed by a bad outbreak, accompanied by diarrhoea and dysentery, and these diseases recurred in spite of the diet being set to right, 5334; it was due to the striking off of the potato or vegetable element, 5334-5; 5354, 5386; and the diminution in the total amount of food contributed to it, 5354; the winter had been cold and damp, and the cells unusually cold, 5353; but these causes would not of themselves have produced scurvy, 5354; a subsequent outbreak among military prisoners due to absence of potatoes, 5382; scurvy formerly was called purples, and associated with it was petechial fever, 5360; it is now very rare among the civil population, 5360; having diminished owing to greater command of vegetables and fruits, 5361; instance of it among gold workers in California, with diet of salt provisions, rum, and coffee, yet no vegetables, 5362; outbreak among Captain Cook's crew in a warm latitude, but a bad season, 5362; outbreak during Irish famine was due to deprivation of vegetable food, and promoted by causes accompanying famine, 5365.

8. Ventilation—

Cubic space important on account of the difficulty attending every method of ventilation, 5367; a vitiated atmosphere not so much fatal to pickled lives as to persons of

GUY, WILLIAM AUGUSTUS, *continued*—

all ages, &c., 5369-70; an infectious malady specially fatal with it, 5369; but the crews of the late expedition had no such malady, and were lives well able to resist its bad effects, 5369-71; 1,000 cubic feet allowed per man at Millbank, 5372-3; John Howard thought this the proper amount, 5372; the prisoners are confined in their cells separately, except for exercise, 5373-4; their health was not affected by confinement, 5375; the space the crews had, inadequate to preservation of health, where there is much confinement, 5403; but not with men working out of doors as an agricultural labourer, 5403; it is questionable whether the sailors in the arctic have similar conditions of out-door life, 5403-4; difficulty of renewal of air in confined spaces, especially with low temperatures, on account of objections to draughts and cold, 5405; it would be facilitated by heating the air admitted, 5406-8; increase of difficulty in ventilation in ships' cabins with want of opposite openings, 5409.

GRAY, ALEXANDER, Ice-Quartermaster.

Subheads 1. General.

2. Diet on Board.

3. Diet, Sledging.

4. Lime Juice.

5. Scurvy and Health.

6. Sledging.

7. Ventilation.

References to—

Commander Beaumont—

Comparative immunity from scurvy due to experience of arctic life, 930.

Dr. Coppinger—

Attack of scurvy, 2748-9.

1. General—

Ice-quartermaster of the "Discovery," 7166-7, 7307; previous employment in whalers, and promotion to be harpooner, 7168-70; had previously wintered four times in the arctics, 7171-2, 7218, 7223; no doctor winters in the whalers which remain to catch whales, the hands being too few to require one, 7184-92; duties as ice-quartermaster, 7308-9; was very happy during the winter in "Discovery," 7310, 7314; had never seen so much darkness, 7312-13; the men generally very happy, 7315; the work enough, and plenty of amusement, 7316; some men in the whalers would not go out, but felt scurvy in the spring, 7318-19; would sit all day on their chests, 7574; no advantage in health in abstainers on board whalers, 7554; amusements on board the whalers, 7567; dancing with Esquimaux, 7567; saw no illness among Esquimaux, 7569.

2. Diet on board—

Provisions in whalers 7200; seal meat obtained from Esquimaux, and was popular with some men, 7200-1, 7268; no other fresh meat, 7268; account of diet on board the whalers, 7255; a liberal allowance of whole or preserved potatoes given twice a week, 7255-65; but not so much as in a Queen's ship, 7266-7; whale was eaten and was good, tasting like periwinkles, 7269-72; what whale they eat, 7569-62; black whale eaten by Americans, not by English, 7562-4; how whale and seal was cooked, 7273-6; objections to blubber, 7277-8; lived upon whale on the pack for fifteen days, on nothing but whale, 7279-83; doubt whether the whalers who had scurvy had vegetables or fresh meat, 7299-7302; molasses used, but not much, 7586-88; Americans use them much, 7589-90; Americans take raw potatoes as pickles, 7591-2; the salt meat not so salt as that of the "Discovery," 7601; food in the late expedition much better than in the whalers, 7202, 7253; the salt beef of "Discovery" considered rather salt, 7204-5; arrangements for meals, and for issue of provisions, 7337-81; preserved meat used at breakfast, but not salt meat, 7338; what vegetables they had at breakfast, 7341-2; salt meat once a week, personally did not eat it, but some liked it, 7346-7; always had meat at dinner, 7348-9; what food was given, 7344, 7350, 7596; saved meat, or eat the whole allowance according to appetite, 7351-4; amount and description of vegetables given, 7356-72; carrots three times a week, 7360; preserved potatoes four times, 7363-66; liked them, and had as much as he could eat, 7367-72; pickles used at every meal, 7377; what kinds they were, 7380; what food they had for supper, sometimes meat, 7376; no extra food given after the watch, 7382; liked the preserved meat, pork, and hotch-potch, 7598-7600; the men had plenty to eat and everything necessary, 7602-3.

3. Diet Sledging—

Rum was issued at night, was popular, would have been liked better at lunch, 7216-17; pemmican was very good, 7450-56; and liked at first, 7450, 7456; the sweet best, 7457; appetites good at first, and for some time, 7451-5; the whole allowance eaten, 7453-4; how the pemmican was cooked, 7458; all the potato eaten, 7460-61; some would have liked more, 7464; not so much potato as on board, 7463; arrangement for meals, and for food given at them, 7467-73; towards the end

GRAY, ALEXANDER, *continued*—

of the journeys the bacon was not eaten, 7474; got enough water, 7476-7; could not carry any at first owing to the cold, 7479; about a pint of tea given, 7491; pork, not pemmican, taken from whalers, 7594-96; diet sledging from whalers less monotonous, being handy to the ship, 7252.

4. Lime Juice—

Use of lime juice on board whalers, 7284-97; irregular measurement, 7287-90; about half-a-gill given daily with sugar and water, 7288-90; it was well liked generally, 7291-2; and never thrown away, 7296; especially with hard work, 7292; some parties did not care about it, 7294; doubt whether the whalers which had scurvy took lime juice, 7299-304; does not know whether ships without suffered more, 7612; lime juice only lately taken compulsorily, 7611; all his ships have taken it, 7616; took it himself to keep off scurvy, but not so much as in late expedition, 7618; not more vegetables taken by ships unprovided with it, 7613-14.

In "Discovery"—

Liked the lime juice given, 7384; every one took the allowance, some would have liked more, 7209-11; it was as good as the whalers, 7385; wheu and how served out, 7388-92; was mixed at the tub, 7393; and drank before an officer, 7396; everyone drank it, 7401; spoils grog wheu mixed with it, 7399, 7400; some could have drank more if allowed it, 7396-7; would have liked it when sledging, 7465-6; difficulty of thawing it and enough water together in the cooking apparatus, 7480-81; objection to mixing it with tea or coffee, 7484-92; appearance and condition of lime juice at Polaris Bay, 7525-37; was darker and more tart than the navy juice, 7533-5; mixed it up with molasses, 7536.

5. Scurvy and Health—

Experience of scurvy in the whalers and American vessels, 7173-81, 7193-4; five deaths from the "Alibi," 7178-93; treatment by the captain ou vegetables, lime juice, and fresh meat; no doctor wintering ou board, 7176-81; cause of scurvy in the whalers, want of exercise in the winter, 7195; it would come out after return and diet of vegetables, 7606-7; what the symptoms were; not the same as in the recent expedition, 7196-8, 7579; thousands of chances more of it in whalers than in the navy, 7203; immunity of officers of whalers, 7570; due to taking more exercise, 7571-2; not to diet, which is much the same as the men's, 7573; has not seen scurvy among the Esquimaux, 7199.

In late expedition, scurvy due to hard work and want of variety of diet, 7248-50; case of Shepherd the cooper, 7402-3; his duties, 7404-6; attack of scurvy, it began before Christmas, 7410-11; was not a strong man, 7413; may have drunk too much in his early days, 7414-15; and possibly on board, 7417; had no command over spirits on board, 7418; the date of ill-health, 7419-21; his symptoms, 7424-8; personally in good health on leaving "Discovery," 7436-7; went with Lieutenant Beaumont's party, 7432; which appeared in good health, 7438; and were fit for any work, 7439-40; no complaint of work or weakness till stiffness began, 7444-8; dates of men falling ill, 7493-6; slight personal attack of scurvy when sledging, 7214-15, 7219; date of his attack, later than the others, 7497-8; seventy-eight days out before he felt it, 7508-9, 7581; they would all have died without assistance, 7502; treatment with lime juice and improvement under it, 7503-7, 7584-5; his symptoms, 7510-17, 7542-5; walked but could not drag to Polaris Bay, 7520-23; never let his spirits go down, 7545; recovery at Polaris Bay after fourteen days' treatment, 7538-41; a change of food the best cure, 7583; no conversation held on board about scurvy, 7605.

6. Sledging—

Sledged from whalers taking blubber to the land to put into casks, 7221-6-7, 7233; travelling some miles backwards and forwards through wet snow in April and May, 7228-31, 7237; the work hard, but not as continuous as in recent expedition, 7232, 7576; used to sleep away from the ship on the land if possible, 7233-8; in canvas tents, 7239; used blubber as fuel, 7241; did not suffer from exposure, but weather was mild, 7242-3; dogs were used, 7244; as great weights sometimes dragged as in late expedition, 7577.

In recent Expedition—

Was captain of Lieutenant Beaumont's sledge, 7441; the crew wrought like men, 7442; did not take physic to prepare himself for sledging, 7548-9; never had harder work, 7575.

7. Ventilation—

In "Discovery"—

What amount of condensation and drip on hammocks there was, 7206-8, 7326-32; chiefly at the time of cooking, 7329; occasionally dripped into the hammocks, 7330-32; arrangements for drawing it off made as much as possible, 7333-34; and for wiping it up, 7335-6; more room and comfort on board the "Discovery" than in whalers, 7317; the main deck comfortable but not warm, 7320-21; not stuffy, 7322; or extraordinarily

GRAY, ALEXANDER, *continued*—

wet, 7323-4; as much or more wet in whalers, 7323; slept in bunks on board the whaler, 7565; liked the hammock on board "Discovery" very well, 7566.

HAMILTON, RICHARD V., Captain, C.B., Superintendent of Pembroke Dockyard, formerly in Austin's (in the "Assistance") and Belcher's ("Resolute") expeditions.

Subheads 1. General.

2. Diet, General.

3. Diet, Sledging.

4. Lime Juice.

5. Sledging.

6. Scurvy.

1. General—

Service in "Assistance," 1850-51 (Austin's expedition), 2994; "Resolute," 1852-54 (Belcher's), 2994; immunity from disease (letter of G. Murray), 2996; deaths from causes other than scurvy, 3013-15; no compulsory outdoor work till spring (letter of G. Murray), 2996; but walking, drill, or training (letter of G. Murray), 2996; the crews in recent expedition too young, 2996; exercise taken in Ross's expedition, 1849, eight hours a day (letter of G. Murray), 2996; average age of men (1852-4), 3017; older than in recent expedition, 3018; some of the men who stood the cold best just returned from Africa, 3016; crew of "Assistance" carefully examined before entry; not so in "Resolute," 3020, 3076; three deaths in "Resolute" amongst men of previous arctic service, 3021; medical instructions when sledging contained no mention of scurvy, 3033; excellent health of "Resolute's" crew when taken on board at Beechy Island, 3036; the "Investigator's" a splendid ship's company, 3037; Austin's crew healthier than Kellett's, though the fresh meat was less, 3047-8; this would be due to greater care in selection of men, 3076; believes recent ships were not so well equipped, and decks damper, 3024-7; warming in former expeditions, 3071; advantage of Sylvester stove supplied to former expeditions, 3071; description of the system, 3073; the "Discovery" difficult to warm with stoves, owing to funnel, 3072; personally was fit in 1854 for another winter, after diet of salt meat, vegetables, and lime juice, 3075.

2. Diet, General—

Little meat obtained by "Assistance," 3019, 3077; 28,000 lbs. by "Resolute," 3019; but little scurvy-grass obtained by "Resolute," 3022; advantage over recent expedition in beef not being so salt, and daily ration of bacon, 3028; how the bacon was carried and stowed, 3029-31; a good deal of beer used and brewed on board, 3034, 3074; no spruce beer, 3035; wine for the sick, 3035; "Resolute" well supplied with vegetables, 3069; of what kinds, 3070; preserved meat more freely used in recent expedition than formerly; disadvantage of this, 3041; both "Alert" and "Discovery" had more fresh meat than many ships, 3045-7; reasons for preference for salt over preserved meat, 3075.

3. Diet, Sledging—

Whether any antiscorbutics were carried besides lime juice, 3004; a gill of rum a-day, issued twice a-day, tea at night, cocoa for breakfast, 3008; advantage of rum at lunch in shorter halt, 3009; advantage of rum at night as conducive to sleep, and preventing cold, if wet, 3009; warmth produced by mixing rum and tea, which was due to the mixture, not to either alone, 3084-7; always mixed tea with rum, 3085; some preference expressed for tea at lunch, 3009; tea would have been better, 3084; smoking disagreeable to non-smokers, but beneficial to smokers, 3010-11; description of what the diet was, 3051; biscuit dust changed to Edwards's potatoes, 3052-3; preserved meat not found so good for travelling on as pemmican (case of Lieut. Mecham's crew), 3057.

4. Lime Juice—

No lime juice taken in Austin's and Belcher's sledge expeditions (letter of G. Murray), 2996; objection to carrying it sledging owing to its weight and freezing, 2996, 3083; the weights being strictly limited, and fuel wanted to thaw it, 3083; objection to halt for thawing water, 3083; case of a man who served in three arctic expeditions and never drank it, 2996; a bottle or two taken in 1851, it was eaten as water-ice within four days, 2998; believes the bottles were quarts, 3000; all used in four days as the bottles had broken, and it would have been lost, 2998, 3001-3; no difficulty in getting men to drink it, but there were exceptions, 3012; lime juice was sent to depots, but not used, 3065; whether a daily ration, 3078; advantage of taking it in a condensed form, 3032; but objection to carrying fuel or mixing it with grog, or tea, 3032; lime juice would not have much lessened the scurvy in the recent expeditions, 3068, 3083; it had been issued on voyages according to instructions, 3079; has always taken his own allowance, 3081; attaches importance to it, 3082.

5. Sledging—

Enumeration of sledge journeys, distances performed, and temperature, 2993-4; officers worked as hard, or harder,

HAMILTON, RICHARD V., *continued*—

as men, 3006; reasons for asserting this, 3088; duties in picking the way and exploring, 3088; want of rest owing to taking sights, 3088; to what extent his responsibility affected him, 3007; in recent expedition the work of Markham and Beaumont's parties more severe than in former expeditions, Lieutenant Aldrich's not so, 3045, 3091; sledge travelling the hardest work the men are put to, 3067; the officer's place in tent more exposed, 3088; he does not cook, 3088; to what extent he helps in dragging, 3088; what the depth of the snow and nature of ice was in his journeys, 3089, 3090; travelling not so heavy as of recent expedition, 3090, 3091; admiration for zeal and determination of recent expedition in overcoming unprecedented obstacles, prudence would have dictated an earlier return, 3091; mutual confidence shown by officers and crew, 3091; courage and patience shown after prostration by scurvy, 3091.

6. Scurvy—

No symptoms in his journeys, 2996-7, 3055, 3066; no man broke down from it, 3055, 3066; no symptoms of it (letter of G. Murray), 2996; no scurvy in Ross's expedition, 1849* (letter of G. Murray), 2996; most of Lieut. Meham's men had sore ankles and feet, due to over marching, 3056-7; how far a case occurred in Mr. Nares' sledge, 3063; no more debility than to be expected from the circumstances, 3067; recovery of "Investigator's" crew when supplied with fresh meat, 3037; they all had scurvy when they came to "Resolute," 3058-9; outbreak in recent expedition due to long absence of sun, want of Sylvester stove, difference in diet on board, youth of crews, 3039-40; not to want of lime juice, or severe sledge travelling, 3039; seeds sown before sledging, 3039; reasons for supposing so, 3045; remarks upon the cases, 3045; it originated in the winter, the travelling hastened and aggravated it, 3068; has no personal knowledge of scurvy, 3043, 3082.

HOBSON, WILLIAM ROBERT, Captain, R.N., formerly in H.M.S. "Rattlesnake" and in the "Fox."

Subheads 1. General.

2. Diet on board.
3. Diet sledging.
4. Lime juice.
5. Sledging.
6. Scurvy.

Reference to—

Sir L. McClintock—

Attack of scurvy, 3352-3.

1. General—

Men less fit for arctic after a winter there, 3437; the best age between twenty-five and thirty-five, 3438; latitude in which "Rattlesnake" wintered, 3516.

2. Diet on board—

Much fresh meat obtained when in "Rattlesnake" and "Plover," 3418, 3452, 3518; vegetable diet when in that ship similar to what is given now, 3453; could buy from the Esquimaux or shoot any amount wanted, 3522-3; seals obtained in the spring and autumn in the "Fox," 3430; got no sorrel or scurvy grass, 3439; game should not be counted on, 3496; the scale of victualling in late expedition corresponds with that of the "Fox," 3497-99.

3. Diet sledging—

Tobacco was used, 3435; little chewing, but smoking liked at night and on halting, 3436; what fresh meat he got in spring journey from "Fox," 3430; sledging from "Rattlesnake," pemmican and preserved potato taken, 3458-9; but pemmican should not be considered, game being plentiful, 3481; pemmican taken from the "Fox," and preserved potato and onion powder, 3482, 3485; the dietary of recent expedition the same as that of "Fox," 3487; and as good as could be, 3540; different from Behring's Strait sledge diet, 3503-4; difficulty in obtaining water, 3509; owing to want of fuel, 3512; suffering from want of, 3510-11; drank it only in tea and cocoa, about a quart a day, 3512-13; men did not eat snow much, 3514; it increased thirst, 3515; men liked tobacco, 3537; great value of tea, 3547; rum should be taken, one gill a day enough, 3548; men worked better after luncheon on it, 3549; what their luncheon used to be, 3549; men have expressed themselves ready to give up rum rather than tea, 3550.

4. Lime Juice—

Did not carry lime juice sledging, 3414, 3460; reasons for not doing so, difficulty of thawing it, objection of men to putting it in tea or grog, 3415; aggravation of thirst if sucked frozen, 3415; lime juice always issued, but to the messes only, 3432-4; did not drink it much, 3443-4; drank very little in "Fox," the supply being short, 3444, 3531; believes it was regularly consumed by the men, 3470, 3479; the full allowance always served out, 3471; did not suspect its quality, 3472; to what extent freezing destroys its properties, 3472-5; suggestion to take it in capsules to prevent necessity of thawing water, 3447-8; doubt whether the acid would destroy the case, 3449; scarcity of, on board the "Fox," 3469; thought

* Note.—Scurvy existed in this expedition.

HOBSON, WILLIAM ROBERT, *continued*—

he could stand anything, and gave up allowance to others, 3531-33; likes it, 3534; it would have mitigated his attack had he taken it, 3535; considers it necessary in arctic expeditions, 3538; it should be taken on long sledge journeys, 3539.

5. Sledging—

Former Expeditions—

Enumeration of sledge journeys, distances travelled, and temperatures, 3408; kept much along the land, very heavy ice between King William's Land and Cape Felix, 3409; difficulty in estimating the depth and character of the snow, 3410; there was a good deal of wind, 3411; great difficulties encountered in autumn journey from "Fox," owing to ice breaking away from the shore, 3420-21; the exposure had no bad effect on the men, but the journey was short, 3422-4; what fresh meat he got in spring journey from "Fox," 3430; sledging from "Rattlesnake," his crew and rations, 3454-8; men used to be weighted to drag 200 lbs., dogs 100 lbs., could not have done the work without dogs, 3463-5; account of ice on journey to Chamisso Island, its hard work, 3519-21.

General—

Inside the broken-up ice, near the land, there is generally a comparatively easy way along the coast line, 3409; aggravation of cold by wind, 3412; suffering from thirst as great as in tropical climates, 3415; work in a dog-sledge quite as great, 3461; same necessity for dragging, 3462; difficulty to get dogs to work in rough ice, 3463; their refusal to move till the sledge is started, 3463; assistance derived from them in dragging part of the weight, 3462-5.

6. Scurvy—

All his men in sledging from "Fox" in spring had scorbutic symptoms, 3413, 3428, 3483; no signs in autumn journey from "Fox," in spite of great exposure, 3421-24; in the spring debility came on before leaving the ship, 3425; had scurvy himself, 3431, 3445, 3526; extent to which he suffered, always did part of the day's work, 3426-7; did not suspect scurvy till he got back, was not well at starting, 3480; no one suspected scurvy, 3525; which the journey was, 3489; the whole party attacked, but himself worst, 3492; the men were debilitated from want of fresh meat and vegetables, 3429; no obvious symptoms, nor were they prevented from work, 3495; was himself able to get about after return to the ship, 3495; they recovered with change of diet and fresh meat, 3495, 3505-6; and lime juice, 3508; the ship's steward of the "Fox," Thomas Blackwell, brought his attack upon himself, 3500; being unsteady and not taking exercise, 3501; no scurvy when in Behring's Strait ("Rattlesnake") owing to fresh meat, 3418, 3450, 3518-24; and to comparatively low latitude, 3517, 3524; had none himself then, 3446; his own symptoms when in "Fox," 3527, 3530; fainting on exertion obliged him to sit on the sledge, 3527; smoking too much may have predisposed him to it, 3535; but observed no similar effects among other men of "Fox," 3536; had a craving for raw meat and fat, 3543-46; but could not eat seal blubber, 3546; never heard of Esquimaux having scurvy, 3441-2; cannot form an opinion as to outbreak in recent expedition, 3540.

JENKINS, WILLIAM, Carpenter's Mate.

Subheads 1. General.

2. Diet on Board.
3. Diet, Sledging.
4. Lime Juice.
5. Scurvy and Health.
6. Sledging.
7. Ventilation, &c.

References to—

Dr. Nimis and Dr. Coppinger—

Attack of scurvy after sledging in North Greenland, 2572-3, 2748-9.

1. General—

Carpenters' mate of "Discovery," 8369-70; was captain of a mess, 8371, 8437; ages of the crew, 8421-3; worked at his trade on board, but did not carry his tools sledging, 8435; what amount of outside exercise he took, 8472-4; did not suffer from his duties, 8475.

2. Diet on Board—

The provisions were more than sufficient, 8502; the provisions good, but continual preserved meat monotonous, 8380, 8497; and the appetite is not sufficient to meet demands on the system, 8497; did not eat the salt meat, 8381, 8461; was beautiful meat, but too salt, 8382, 8424, 8463, 8501; salt meat considered bad for scurvy, 8382, 8461; it was objected to on that account, 8462; used spare preserved meat in lieu, 8382; the pork good, better than any he had had before, 8383-5, 8425; it was not fishy, though some thought it so, 8503; the collops were disliked, 8426-7; being like sawdust, 8427; the other preserved meat very good, 8429; vegetables issued every day, 8452-3; carrots and cabbage good, but not the onions, 8453-5; quite sufficient potato issued, 8456-7; liked the seal meat at Polaris Bay, 8476 (see

JENKINS, WILLIAM, *continued*—

also under Scurvy for food at Polaris Bay); it was bad to look at, 8477; how obtained, 8481; what game was got, 8481-4.

3. Diet, Sledging—

Tea best for travelling on, 8420; rum good at night on turning in, 8420; potato issued daily, perhaps as much in the aggregate as on board, 8458-9; water was good, but sometimes a little salt, 8464-5; suffered from thirst, and eat ice, 8466-7; could not suggest any improvement, 8498, 8500; pemmican very substantial, 8498; plenty in quantity of provisions, 8508; but limited in kind, 8507.

4. Lime Juice—

Took his full allowance regularly, 8386, 8436; and liked it, 8387, 8432; had none sledging, but got some when on board "Alert," 8388-91; every one took it there, 8450, 8504-5; and liked it, 8492, 8504; arrangements for serving it out, 8450; that at Polaris Bay rather stronger than the navy juice, 8468-70; it would not cure scurvy without a change of diet, 8491; it was considered a preventive of scurvy, 8493, 8505; they were ordered by the medical officer to drink it regularly, 8505.

5. Scurvy—

When his first symptoms began, 8392; his symptoms, 8393, 8417-19; had to be carried before reaching Polaris Bay, 8394-5; sufferings whilst carried, 8410-13; was very ill, and appetite very bad on arriving, 8478-9; desire for change of food, 8486; treatment at Polaris Bay on lime juice and game (for food at Polaris Bay, see also Diet on board), 8397-8401; had no appetite for pemmican or preserved meat, 8398, 8402; had not eaten pemmican for some time, 8486; but took potato, biscuit, and tea, 8487; ate a great deal of seal meat and game, 8401-2; had a craving for it, 8414; took a great deal of lime juice, 8403-4; had a craving for it, 8415; returned to ship before he could drag, 8405-7, 8488; recovery on board, 8408-9; scurvy was not thought of, 8495; was attributed to cold, limited kinds of provisions, sledging, and monotony of diet on board on preserved provisions, 8496-7; any sledge party going over the same ground would have scurvy, 8499; ease of Shepherd, he was delicate, 8440, 8444; and had not a good appetite, 8441-2-7; what he eat, 8443; did not eat salt meat, 8445; he was very ill, 8451.

6. Sledging—

Was in the North Greenland sledge party, 8372; his tools would have been serviceable, 8435; the sledge crew as good as could be picked, 8499.

7. Ventilation—

Where he slept, 8373-4; the berth very comfortable, 8375; more room than in other ships, 8376; suffered from the drip when in bed, 8377, 8431; covered his hammock with an oilskin, 8377, 8431; no possibility of preventing it under the situation, 8378, 8431; the mess place was very comfortable, 8379; a great deal of damp on the lower deck, 8431; its increase with increased fire, 8431.

LEACH, HARRY, M.R.C.P.L.

Subheads 1. General.

2. Lime Juice.

3. Scurvy.

4. Ventilation and accommodation on board Ship.

1. General—

Medical Officer of Health for the Port of London, and Medical Referee of the Board of Trade, 5536; lately Senior Medical Officer of the "Dreadnought," and is a Visiting Physician of the Seamen's Hospital, Greenwich, 5537; employment by the Board of Trade to inquire into outbreaks of scurvy, 5540; the Americans use vegetables and molasses, not lime juice, as antiscorbutics, 5574-5; molasses are valuable, but not convenient for stowage, 5577; the antiscorbutic virtue in dried vegetables and preserved potato not yet ascertained, 5597; scales of vegetables, convicts and merchant seamen, 5597.

2. Lime Juice—

Occurrence of scurvy with good lime juice, but bad or insufficient animal food, 5544-8; decrease of 70 per cent. in mercantile marine since the Act of 1867, assuring the quality of lime juice, 5541; the character of lime juice previous to 1867, glaringly defective, 5556; one-third shipowners use lime, two-thirds lemon juice, the latter used in consequence of insufficient supply of lime juice, 5557; lime juice the most antiscorbutic, 5558; the citric acid varies with the time of picking the fruit, 5559; the juice is examined under Customs' arrangement in bond at the Inland Revenue Laboratory, 5561-3; it is certified and fortified, sealed and issued only for seagoing purposes, 5564-7; the limes chiefly come from Montserrat, the lemons from Sicily, 5570; it is not highly thought of in the United States, 5572-3; 1 oz. of lime juice the daily ration in some merchant ships, 5597; importance of the omission of lime juice in the sledge dietary of the recent expedition, 5599; the scurvy would not have been what it was if taken sledging, 5596; it the most efficacious antiscorbutic substitute for vege-

LEACH, HARRY, *continued*—

tables, 5599-601; the outbreak in the recent expedition due to its absence, 5602-6.

3. Scurvy—

Causation of scurvy, want of antiscorbutics, such as fresh vegetables, &c., 5542; bad or insufficient animal diet, 5543-9; that is, scurvy may occur under these circumstances with good lime juice, 5548; but exceptionally, 5554; instance of scurvy occurring, owing to want of good animal food, in the "Royal Sovereign," 5544; possibility of the occurrence of scurvy with vegetable food after a prolonged interval, 5551; but scurvy most generally due to absence of vegetable food, 5555; it would not have occurred, as it did in the recent expedition, had a special class of antiscorbutic been taken sledging, 5596, 5602-6; the potato taken insufficient, 5597; the conditions of darkness, cold, &c., only predisposing causes, 5604; the immunity of officers similar to that in the merchant service, and due to superiority of stamina, diet, clothing and education, 5607-9; the extreme exertion of the sledging parties increased the severity, but did not originate the disease, 5610-11; idleness and dirt the favourite causes of scurvy in the opinion of merchant captains, 5612; want of washing would help the disease when originated, 5613; but is not a necessary antecedent or predisposing cause, 5614-15.

4. Ventilation and Accommodation on board Ship—

But little to complain of in the ocean-going merchant ships as to accommodation of seamen, 5579; the minimum allowed, 72 cubic feet and 12 superficial feet, 5580-81; no system of heating in ocean-going ships; he objects to stoves in coasters, 5582-3; not necessary, 5584; considered the "Alert" and "Discovery" were closely packed, 5586-7; without as much space as usual in the navy, 5588; but allowance for retention of heat and stowage is necessary, 5589-90; difficulties would exist in renewal of air, 5591; the cold outer air adding to them, 5592; advantage of heating admitted air if practicable, 5593.

LYALL, DAVID, Esq., M.D., Deputy Inspector-General of Hospitals and Fleets, formerly of the "Assistance."

Subheads 1. General.

2. Diet.

3. Diet, Sledging.

4. Lime Juice.

5. Sledging.

6. Scurvy and Health.

7. Ventilation.

1. General—

Served in antarctic (1839-43), in the "Assistance" (1852-54), 4264-5; the longer men remain in the arctic regions the weaker they get, 4315; the best age from 24 to 34, 4316, 4402-3; to what extent men of the late expedition were younger, 4404; men sent out for exercise twice a day, 4324; routine of the ships in the late expedition similar to that of "Assistance," 4325; was connected with the Arctic Committee, 4382; and consulted as to provisions and clothing, 4383-4.

2. Diet—

The scale of victualling on board the "Assistance" varied from time to time, 4288; much the same as that of the late expedition, 4345; found no game, 4317; nor scurvy nor sorrel-grass, 4318; grew a little mustard and cress, 4319; tobacco in moderation advantageous, 4328; list of vegetables supplied in "Assistance," 4346; two kinds of potato, 4347; preference for Edwards's, 4348; the "Resolute" and "Investigator" had fresh meat, 4368; the "Assistance" hardly any, 4368; the scale of diet in late expedition sufficient to maintain health, 4289; his opinion as to dietary of late expedition was asked, 4385; and it was in accordance with his views, 4386; it was founded on experience of other expeditions, 4387-8; no reduction made of substances contained to their food elements, 4389; to what extent condensed milk was supplied, 4390-94; was given as a medical comfort, or when necessary, 4395; eggs will not keep very long at sea, 4396-7; does not recommend taking them, unless preserved in better ways, 4398; superintended corning of the beef supplied to the late expedition, 4405; was satisfied with it, 4406; it was the same meat as was used in former expeditions, of the best quality, and salted in the ordinary way, 4407; preserved meats rather insipid, 4411.

3. Diet, Sledging—

Dietary of recent expedition similar to that of "Assistance," except lime juice, 4295; he did not give any advice about it, 4399; both rum and tea good in their way, 4312; rum was useful, 4312; it was used in antarctic expedition, where health was very good, 4412; had a cheering effect at the end of the march, 4412; the men being too chilled to take off their boots till they drank it, 4412; had it in the arctic for luncheon and supper, 4413; after luncheon they worked better at first, but the effect soon worked off, 4414; but the men are more tired the second half of the day, 4414; prefers rum at night, tea for mid-day meal, 4413, 4415; but objects to a long halt for making tea, 4313; thinks the "Assistance" had only

LYALL, DAVID, *continued*—

one ounce of preserved potatoes a-day, 4349-51; no other vegetables, 4350; the chocolate supplied to the recent expedition was Moore's, 4392; the sledge diet should be more varied, and have more vegetables, 4409; preserved meat as a change on pemmican advantageous, 4410.

4. Lime Juice—

Lime juice served out regularly in the "Assistance," 4290; was taken from the tub, 4292; and carried below, 4300; no officer specially saw it taken, 4291; believes all of them took it, 4293, 4299, 4301; knew of no exception except perhaps among officers, 4302; did not connect symptoms of scurvy with not drinking lime juice, 4294; $\frac{1}{4}$ ounce the daily ration when sledging, 4295, 4352; does not recollect using it, 4297, 4305, 4353, 4371; nor taking it himself, 4299, 4354; it was carried in a tin can, 4304; believes it was not taken the early part of the season, but left in depot, 4418; it should be taken sledging, but there is difficulty in using it in, 4296; does not think it deteriorated in the arctic, 4303; it is useful as an antiscorbutic, 4306, 4416; but will not prevent scurvy altogether, 4306; would carry more vegetables sledging or more lime juice than they did, 4307; taking it sledging is of great moment, 4421; objection to taking it undiluted as injurious to the mucous coat of the stomach, 4308; possibility of its being carried in capsules and mixing it with rations, 4309-11; advantage of doing so in obviating necessity of thawing water for it, 4310; men who have taken lime juice up to the time of sledging might ward off an attack of scurvy, 4417.

5. Sledging—

Enumeration of sledge journeys on which he was engaged, 4266; description of them in Sir E. Belcher's expedition, 4337-41; were with man-sledges, 4342; the nature of the ice varied, the work very hard when rough, 4343; very difficult and trying when thin, 4343; the ice more or less rugged, but sometimes smooth along the shore, 4422; the snow generally firm enough to bear the sledges, 4423; after it began to melt, the men would sink up to their knees where it had drifted, 4423-4; their difficulties nothing to compare with those of late expedition, 4425; as they seldom had to double bank, and advanced much faster, 4425.

6. Scurvy and Health—

No case of scurvy in the "Assistance," 4287; but some signs of, 4287; did not connect it with not drinking lime juice, 4294; was not restricted either to the ship or sledging, some cases occurred sledging, but partially recovered before return, 4344; when taken on board the "Phoenix," many had scorbutic taint, 4320; there would have been a good many more after another winter, 4321; but they were comparatively free for the first winter and season, 4322; several cases occurred in the following year, 4361; on board the "North Star," from crews of deserted ships, 4362-4; considerable exertions necessary to reach "North Star"; very little exertion brought out scurvy in their condition, 4365; what their dietary had been, 4366-8; liberal in vegetables and lime juice, except in "Investigator," 4369-70; Captain Richards' men had swelled ankles, but all men were working, and soon recovered; there was enough to account for it otherwise, owing to exposure wading, 4419; comparative immunity of "Assistance" due to cleanliness, decks being kept dry, and men being obliged to take exercise, and not allowed on lower deck, 4427; the shorter period of darkness may have affected the case, 4428; has heard of Esquimaux having scurvy, 4329-30; had no scurvy in the antarctics, 4335; good state of health in the antarctic, though five months in the ice, 4412; in "Assistance" a man sent back from sledging had symptoms, but it was not put down to it, 4356; Lieutenant Osborn and one of his crew had symptoms, but they were both better when they returned, 4358-60; some symptoms occurred in his journeys which he could attribute to it, 4426; in recent expedition, may have been partly attributable to the long absence of light and greater degree of cold, possibly to greater dampness, 4323-4, 4377; or less exercise than in former expeditions, 4324; but those conditions are not necessary antecedents, 4378-80; cannot give any opinion as to any further cause, 4380-81; to what extent the longer darkness on board the "Alert" may have caused a more severe outbreak than in "Discovery," 4430-41; it could not have accounted for it altogether, 4437; there must have been some other cause operating, 4441.

7. Ventilation—

Ventilation of "Assistance," 4267-87; improvement the second winter, 4267, 4281; by building a house over the main hatchways, 4267-69; only one hatchway used to go on deck, 4273; thus preventing rush of cold air in when opened, 4267; uptakes from fires, cooking apparatus and stoves, 4268; less drift, 4282; tanks with manholes over the fore hatchway for condensation of heated air, 4274-5; a Sylvester stove used, 4277; where it opened into, 4279-80; preference for it with sufficient coal, it requiring a great deal, 4326-7; condensation froze on

LYALL, DAVID, *continued*—

lower part of upper deck, 4283; the men suffered from it at night, 4285; and he had it in his cabin, 4286; the lower deck was cleared twice a-day, 4324; the air not altogether satisfactory, 4374-5; he visited "Alert," and "Discovery," and considered them roomy and comfortable, 4400.

M'CLINTOCK, SIR F. LEOPOLD, K.G., Superintendent of Portsmouth Dockyard, formerly in the "Enterprise" with Sir J. Ross, 1848-49; the "Assistance," 1850-51; the "Intrepid," 1852-54, and the "Fox."

Subheads 1. General.

2. Diet on board.

3. Diet, Sledging.

4. Lime Juice.

5. Sledging.

6. Scurvy or Disease.

7. Ventilation.

Papers handed in by—

Sections and plans of "Alert," "Discovery," and "Resolute"	No. in Appendix. 22
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Reference to—

Dr. Scott—

Volunteered to remain another year in the "Arctic," when in Sir E. Belcher's expedition, 3942.

1. General—

Seamen between twenty-five and twenty-six less liable to be scurvy-stricken than men over thirty, 3310; acclimatization does not promote immunity from scurvy, 3316-17; all arctic travellers temperate, 3318; no advantage in tectotalers, 3319; dangerous effects of intemperance on the constitution, 3320; the general arrangements of recent expedition considered by the Arctic Committee, 3371; depressing effect of absence of light, physically, it was general; mentally, partial, 3381; selection of men of the "Fox," no examination, most of them had previous arctic service, and were men-of-war's men of good character, 3400-1; a vessel of 600 tons best fitted for the arctics, 3403; a crew of 60 necessary for sledging, 3403; better to have the two ships together for extensive sledging, 3404; a supporting vessel necessary for safety, 3404; information to be furnished to the Committee, 3405.

2. Diet on Board—

The diet of recent expedition more liberal than before, 3262; it was sufficient to preserve men in health, 3263; it could not be materially improved, but should be frequently varied, 3397; less salt meat and more preserved fruits and vegetables desirable, 3397; the diet was framed independently of supply of game, 3398; extra food used to be given in special night work (biscuit and coffee), 3285-6; sugar beer manufactured in Belcher's expedition, 3297-99; no other beer, 3299; a little mustard and cress raised in his ship, 3307-8; what vegetables they had in the "Enterprise," 3363; they were short of weight, 3364; the scale of diet was considered by the Arctic Committee, 3371; advantage of fresh meat (sea birds) in restoring health of "Enterprise," 3391.

3. Diet Sledging—

With Sir J. Ross meat half salt and half preserved, no pemmican, 3250; the diet of recent expedition much the same as formerly, but more biscuit and tea, 3267-8; could not be changed for the better, 3269; got no sorrel or scurvy-grass, 3305; but a good deal of game, 3306; the pemmican used in late expedition the same as in his, 3350; i one kind of it had sugar, 3351; diet of Sir J. Richardson, 3387-90; advantage of fresh meat in his journey to Melville Island, 3392; the amount got, 3393; it was eaten cooked, 3394; condensed milk taken, but as an experiment, 3402.

4. Lime Juice—

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MACDONALD, JOHN D., M.D., F.R.S., Deputy Inspector-General of Hospitals and Fleets.

Subheads 1. General.

2. Diet on Board.

3. Diet Sledging.

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Subheads 4. Lime Juice and Acids.

5. Scurvy.

6. Scurvy in Recent Expedition.

7. Ventilation.

8. Air.

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MARKHAM, ALBERT H., Captain R.N., Commander of H.M.S. "Alert."

Subheads 1. General.

2. Diet on board Ship.

3. Diet, Sledging.

4. Lime Juice.

5. Routine of Ship, Health of Crew.

6. Sledging.

7. Scurvy.

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Papers handed in by—

Sledge party return

Remarks on Dr. De Chaumont's estimation of the work done sledging

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MAY, WM. HENRY, Lieutenant, R.N.

Subheads 1. General.

2. Lime Juice.

3. Sledging and Sledge Diet.

4. Scurvy.

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3. Sledging and Sledge Diet—

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MITCHELL, THOMAS, Paymaster, R.N.

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MOSS, EDWARD, M.D., Staff Surgeon R.N.

Subheads 1. General.

2. Diet.

3. Diet, Sledging.

4. Health of Men and Medical Examination.

5. Lime Juice.

6. Sledging.

7. Scurvy, Cases of.

8. Scurvy, Causes of, &c.

9. Ventilation and Hygiene.

References to—

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MUNRO, WM., M.D., C.B., Surgeon-General.

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2. Lime Juice and Spekboom.

3. Scurvy, Causes of.

4. Scurvy, Instances of.

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MURRAY, MR. WILLIAM.

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2. Diet.

3. Sledge Diet.

4. Lime Juice.

5. Sledging.

6. Scurvy.

7. Ventilation and Accommodation.

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NARES, SIR GEORGE S., K.C.B., F.R.S., Captain R.N.

Subheads 1. General.

2. Diet on board Ships.

3. Diet Sledging.

NARES, SIR GEORGE S., *continued*—

Subheads 4. Lime Juice.

5. Selection and Examination of Men, their Health, Medical Arrangements, and Medical Instructions.
6. Routine of the Ships, Exercise, Sledge Training, &c.
7. Scurvy.
8. Sledging.
9. Ventilation and Warming Arrangements.

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References to—

Lectures given by him, 1348-50 (Commander Aldrich).
Instances of scurvy in his sledge when in the "Resolute," 3063 (Captain Hamilton).

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NINNIS, BELGRAVE, M.D., Fleet Surgeon R.N.

Snbheads 1. General.

2. Diet.

3. Diet, Sledging.

4. Health of Men, Medical Examinations, &c.

5. Lime Juice.

6. Sledging.

7. Scurvy, General, and Causes of.

8. Scurvy, Cases of.

9. Ventilation and Hygiene.

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Appendix.

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OMMANNEY, ERASMUS, C.B., F.R.S., Vice-Admiral, Captain of the "Assistance," 1851.

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2. Diet.

3. Diet, Sledging.

4. Lime Juice.

5. Sledging.

6. Scurvy, Health.

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Enumeration of sledge journeys, 5730; preparation made for sledging, 5753; and warm bath given, 5753; returned in perfect health, except for frost-bite and snow-blindness, 5755: a short rest, baths and fresh meat given, and men resumed duty in two days, 5755; the officers did not usually pull, with certain exceptions, 5770; walking training commenced in March, with ten or twelve miles walk, 5810-12; and practice in sledging with ballast, 5810-12; was himself absent sixty days, 5820; snow six or eight inches deep, sometimes ice hummocky, 5821, 5888; he always avoided over exertion, 5824; description of the ice he met, 5888-9, 5917; some of it, about Cape Walker, something like what the recent expedition encountered, 5889; being very rough travelling, 5917; average journey of ten or eleven miles a-day on the other ice, 5917; suffering from confinement in tent during snow storm, 5918; weights carried, 5860; they diminished with progress of parties, 5861-9; the sledges were man-sledges, 5862; what they and their crews were, 5863-6, 5874; weights in his sledge division ranged from 207 to 190 lbs., 5867; in another sledge, from 224 to 196 lbs., 5868; no increase from illness, 5870-71; more exertion and fatigue in the recent expedition on account of difference of ice, 5823; their ice much more formidable, and the temperature lower, 5918; Lieutenant Aldrich's travelling good, but the snow softer and more wet, 5918; in his own journey there was more suffering from wind, 5918.

6. Scurvy, Health—

The sick list in "Assistance" very small, 5749; perfect health the whole time, 5756; no symptoms of scurvy, 5750, 5756, 5803-7; entries from his journal showing the small number on the sick list, 5758; men started sledging in perfect health, 5752; and returned so, except for frost-bite and snow-blindness; no one on sick list, 5755; sick list July, 5871-3; no symptoms of scurvy sledging, 5769, 5818, 5828-9, 5895; men examined by medical officer on return, with satisfactory result, 5826-7; slight rheumatic pains in one man, but only temporarily, 5830; crew quite able to undergo another winter, 5774; frost-bites occurred in sledging, not in the winter, 5806; one man sent back from frost-bite, 5870; six cases of it, 5872-3, 5893; cases due to inexperience at starting wearing leathern boots, 5893; some severe snow-blindness sledging, 5891; it arose from want of precautions, 5892; inutilty of crape veils, advantage of goggles, 5891; amputation of one man's great toe, 5894; arrangements for rest and special diet on return of sledge parties, 5755, 5896; was personally better on return from sledging, 5897; immunity from disease due to good arrangements, food, ventilation, and recreation, 5898; symptoms of scurvy in the White Sea Squadron, want of food other than ship's provisions, severe weather and confinement to ships, 5902-3; scurvy amongst the Irish during the famine, 5903-6; occurrence of scurvy in prisons, 5850; Esquimaux are carried off by some sort of epidemic, 5780; opinion upon outbreak in recent expedition, 5782-5; importance of ventilation, exercise, and regular hours for meals, 5782; darkness, fatigue and cold would tend to produce it, 5783, 5845; excess of fatigue should not necessarily be accompanied with it, 5784; but might tend to produce it, 5845; not due to want of lime juice, 5785; living in a bad atmosphere, with all apertures closed, conducive to scurvy, 5846-9; difference between officers and men possibly accounted for by different atmosphere, 5856.

7. Ventilation—

Ventilation of "Assistance," pains taken by Captain Austin, 5731; deck kept as clear as possible, 5731; apertures of the hatchways kept open, except in extreme cold, 5731; temperature from 49 to 50 degrees on lower deck, 5731, 5791; cowls fitted for carrying off vitiated air, but no downtakes except hatchways, 5732; the Sylvester stove, 5731; its warm-air flues did not extend to the captain's cabin, 5736; the officers complained of too much hot air from it, 5736; what apertures it had, 5733-5; advantage of these arrangements in ventilation

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and temperature, 5792-3; routine of the "Assistance," 5737; moisture on the surface of the bolts coming through to lower deck frozen, 5738; no drip on the beds of the officers, 5741; his cabin, the coldest but seldom below freezing point in the morning, 5741; statement of temperatures on board and outside, the winter of 1850-51, 5791; the fresh air from the hatchways, heated previous to admission, 5794; that from the Sylvester stove was, 5794; liability to scurvy of former expeditions owing to bad air, caused by closing every aperture, 5848; the "Assistance," a very good ship for the arctic, an old teak ship, dry and spacious, 5856, 5880; advantage of having a ship and steam-tender against a steamship, in cubic space not being taken up with machinery, 5880; the "Assistance" had more space than the "Alert," "Discovery," or "Resolute," 5881; the ventilation in her as perfect as possible, 5882; advantage of heating the air before admission, if possible, 5883.

ORGAN, JOSEPH.

Subheads 1. General.

2. Diet.
3. Diet Sledging.
4. Lime Juice.
5. Sledging.
6. Health and Scurvy.
7. Ventilation.

1. General—

Served in "Enterprise," 1848-9, 6529; ice-quartermaster of the "Resolute," 1850-51, 6529; and of "Pioneer," tender to "Assistance," 1852-54, 6529; has passed four winters in the arctic, 6531; was nearly a teetotaler, 6765-6, 6825; the "Assistance" and "Resolute" about alike in accommodation, every comfort in each, the "Enterprise" not equal 6558-9, 6795-6; the "Resolute" more comfortable than the "Enterprise," 6550.

"Enterprise"—

The work round the ship, dragging ballast, harder in the "Enterprise" than the work in the "Resolute," but not harder than travelling, 6552-7; what exercise was taken, difference between the "Enterprise" and other ships, 6806-7; about five hours a-day work out of doors, 6556; she wintered in Leopold Harbour, 6799.

"Assistance" and "Resolute"—

The "Resolute" wintered near Griffith's Island, 6800; not a better position than the "Enterprise's," 6801; what the walking training was in "Resolute" or "Assistance," three or four hours of it, 6729-32; weather permitting, 6731-2; not stopped by weather more than twice a-week, 6735; began training as soon as daylight thoroughly permitted, in the beginning of March, 6736-8; it lasted a fortnight or so, 6739; more training exercise than in "Enterprise," 6807; outside exercise compulsory, darkness never prevented it, 6740-52; about four or five hours outside the ship in the winter, 6744, 6786; what exercise and games they had on board the ship, and when weather prevented going out, 6746-52; further account of work and exercise, 6805; taken equally all the winter except with much wind, 6808; arrangements for washing and washing clothes, 6753-56; warm water supplied, 6756; the petty officer of the mess supervised its being done, 6760-62; did not take medicine before sledging, 6763-4; too much exercise cannot be taken whilst men can stand outside, 6788; doubt whether enough was taken in the recent expedition, 6785-7; advantage of experience, 6575; was better on last voyage than the first, 6574-6; and willing to remain another winter, 6581.

2. Diet—

In "Enterprise"—

What the diet was, 6537; not enough to eat, 6538; provisions bad, 6604; preserved meat very bad, 6539; also the salt meat, 6594; got a good deal of fowl (looms), no muck ox, 6590-1, 6790; the preserved vegetables very good, 6595-6; what they were, 6597-8; plenty of them, 6603; about half-a-ponnd a-day, 6605-6; potatoes three times a-week, 6608.

In "Assistance," and "Resolute"—

Quite sufficient provision, 6560, 6659; three sorts of potato, 6598-9; preferred the French sliced potatoes to Edwards's, 6600-1; the provisions in "Assistance" very good, 6657, 6682; plenty of everything, 6659; mustard and cress grown, 6715; what amount of game they had, less in the "Resolute" or "Assistance" than the "Enterprise," 6789-94; the salt meat they used was considered by the men likely to produce scurvy, 6812-13.

3. Diet Sledging—

In "Enterprise."

Took concentrated pea-soup, salt pork, and bad preserved meat, 6628-30; no potatoes or vegetables, 6629.

In "Assistance."

Three kinds of pemmican carried, 6666, 6692-3; and issued, in turn, 6667; the currant kind most liked, 6668; 1 lb. biscuit a day given, 6669; and a small daily ration of Edwards's potato was cooked with the pemmican, 6671-3, 6694; pickled onions taken by

ORGAN, JOSEPH, *continued*—

Admiral Osborn, 6694-6706; how made and eaten, 6703-8; some game got on journeys with Admiral Osborn, 6709; no game or vegetables in 1854 journey, 6710-16; advantage of rum at the end of the day when tired or cold, 6767; in keeping up warmth after ceasing dragging, 6777; spirits have saved many a man, 6777; advantage over tea in not wanting preparation, 6777; and by acting as a stimulus enabling men to do a little more work, 6778-82; work well done whilst the grog lasted, 6782; took rum twice a day, 6769; before tenting, 6770; tea after supper, 6770; chocolate given for breakfast, 6771; tea did not prevent sleep, 6775-6.

1. Lime Juice—

In "Enterprise"—

Lime juice issued every day, 6544, 6619; to the messes, 6545; took his ration himself, and believes every one did, 6546-48, 6620; supervised its being taken, 6621.

In "Assistance"—

Always took it on board ship, 6572; being separately served out to messes, 6573, 6683; about one ounce, 6684.

Sledging—

Did not take it sledging, 6571; difficulty of carrying it, 6584-7; did not take it from "Enterprise," 6632; nor from "Assistance," 6674.

General—

Every one should take it, enforced its being taken, 6583, 6820-1; considered it would prevent scurvy, 6813-23; has always taken as much as he could get, living in hot countries chiefly on lime juice and biscuit, 6824-5.

5. Sledging—

Enumeration of sledge journeys, 6530, 6622; had to return from journey in May, from "Enterprise," with Sir James Ross, owing to frost-bite, 6624-7; heavy snow in travelling, and illness of some of the parties, 6637-43; his journey with Lieutenant Osborn, from "Assistance," 6664; cannot wash sledging, except the face, in mild weather, 6759; the men slept well, 6772-4; they were very tired, 6776.

6. Health and Scurvy—

In "Enterprise"—

Several sick, 6542; unaware of their being cases of scurvy, 6540-3, 6610-17, 6809-11; men suffered from the damp, and there were a few colds, 6588-9, 6610; men were in good health at end of winter, 6610; some cases of frost-bite, suffered himself, 6618; how his case was caused, 6633; illness of twelve men out of forty of party sledging, 6636-43; due to heavy snow travelling, 6641; the sick men were sent back by depot sledges, 6643-4; but soon got fit for work, 6649; the rest of the party returned in good health, 6646-9; never heard of the disabled men having scurvy, 6651.

In "Assistance"—

One or two men had swelled legs when sledging, 6575; remained with one in a snow hut at the Cape Lady Franklin depot for twenty days, 6562-70; health at end of winter very good, no illness, 6661-3, 6687; heard of no symptoms of scurvy in any party sledging, 6675-8; two men died, 6685-6; but not of scurvy, 6688; men in 1854 returned in good health, 6717; never heard of scurvy in all his long parties, 6585; saw a case of scurvy in a merchant ship, 6814-15; scurvy in late expedition perhaps due to bad ventilation or want of exercise, 6582, 6783; reasons for thinking they had not enough exercise, 6784-7.

In "Resolute"—

One death from frost-bite, 6818.

7. Ventilation—

In "Enterprise"—

Lower decks very damp and cold; much moisture and ice, partly due to galley, 6720; Sylvester stove used, 6535-6, 6718, 6720; the lower deck was not crowded, 6719-20; and did not smell stuffy, 6723; ventilation defective compared with other ships, 6797; more moisture than in his other ships, 6798.

In "Resolute"—

Better ventilation than the "Enterprise," 6551; good ventilation and no damp in "Resolute" and "Assistance," 6724-5; the deck would have been wet if not wiped 6726-7.

PARR, ALFRED A. C., Commander R.N.

Subheads 1. General.

2. Diet.

3. Lime Juice.

4. Sledging.

5. Scurvy.

Reference to—

Captain Markham—

Discoloration of legs when sledging, 627, 687.

1. General—

Service in the "Alert," 1410-11; no depression of spirits experienced, 1458; suffered from snow blindness, 1512; symptoms of this, 1513.

2. Diet—

Preference for tea over rum for lunch, 1464, 1516; more fit for work after tea, without the unpleasant reaction

PARR, ALFRED A. C., *continued*—

produced by rum, 1516; and which produced weakness, 1517-18; would not abandon rum, 1465, 1519; it is comforting after supper, and helps sleep, 1520; men did not smoke much, but smoked himself, 1466-7; difficulty about it in cold weather, 1468; one man smoked and chewed tobacco; his exemption from scurvy, 1469-72; potato carried in bags, 1488; remained perfectly good, 1489; it was cooked and eaten with the pemmican, 1490; the full allowance eaten at first, not after by sick, 1491; both plain and sweet carried, 1492; it had to be eaten with salt, 1493-5; it did not produce thirst, 1498; sick men preferred bacon, 1497; what water they used, 1502; his appetite remained good longer than that of any one else; was always able to eat his allowance, 1504-7; the food ample in quantity, 1476; and of good quality, 1477; but other articles should be tried, 1477.

3. Lime Juice—

What lime juice they had on northern party, 1431, 1446, 1482; how the bottles were carried, 1481; the neck of one broken, 1484; it was intended for the sick, 1447, 1487; used when symptoms proved to be scorbutic, 1432; difficulty in thawing it, 1433; how administered, and when, 1434; how long continued, 1435; none found at depot on return, 1436; it should be a daily ration when sledging, 1438; mixture with tea unpalatable in the necessary quantities, 1462-3; men glad to get it when they knew they had scurvy; no craving for it with one man who disliked it, 1522.

4. Sledging—

Enumeration of sledge journeys, 1412; what his autumn journeys were, 1413-14; weights in second autumn journey, 200 lbs., 1416; health of crew not affected, 1418; bad frost-bites in second journey, 1419; great inconvenience in the autumn, travelling better in spring till the shore was left, 1421-2; chief difficulties in spring due to hammocks, the snow deep and soft but better than in autumn, 1423; what would have been done had he been unable to reach the ship, 1443-5; advantage of a doctor having accompanied them, 1450; medicines taken, but no medical comforts, 1448; all the equipments good, 1451; helped personally to make roads, and afterwards to drag, 1452; undesirability of hard work at first, 1453; efforts made to prevent overwork, 1454; attack of snow blindness, 1513-14; recovered before it was necessary to make a road, 1515; the depth of the snow, 1523; up to the knees or waist amongst the hammocks in the autumn, 1524; snow shoes would have been an advantage, 1525.

5. Scurvy—

No symptoms of it in autumn travelling, 1420; date of first appearance of it in spring, 1424-5; at furthest point of journey, three men in his sledge unable to walk, 1426-8; the prostration of two men sudden, of the third gradual, 1429; what remedies were given, 1430; had no medical instructions regarding it, 1439; had, personally, slight symptoms on reaching the ship, 1440; what they were, 1505; immunity due to not working so hard at first, 1452; imagines his good appetite and good health reacted on each other, 1507; what would have been done had he been unable to get assistance, 1443-5; probably more than one man would have died, 1443; considers it greatly due to prolonged absence of the sun, 1455-7, 1460, 1508; to what extent so, 1460, 1480; and to confinement and dampness, 1460; and want of sufficient of the food calculated to keep off the disease, 1474-8; insufficiency of food the primary cause, 1479; comparative exemption of George Winstone who smoked and chewed tobacco, 1469-72; the hard work he underwent was an aid, not a cause, in producing the disease, 1509-10; does not attribute it to cold, 1511.

PAVY, FREDERICK WILLIAM, M.D., F.R.S.

Subheads 1. General.

2. Diet, General.

3. Diet on Board.

4. Diet, Sledging.

5. Lime Juice.

6. Sledging, Recent Expedition.

7. Scurvy.

8. Health and Scurvy in Recent Expedition.

1. General—

Fellow of the Royal Society, of the Royal College of Physicians, Physician and Lecturer on Physiology at Gny's Hospital, 5139a; and author of a Treatise on Food and Dietetics, 5140; has devoted attention to dietaries and food principles, 5141-6; opinion on the facts of the case, 5147; the long period of darkness experienced in the late expedition, 5147; extreme cold drives the blood to the centre of the body, exposure to heat induces increase of vascularity, 5203.

2. Diet, General—

Importance of fresh animal food in protecting from scurvy, 5149-53, 5155-9, 5151, 5170; though the absence of fresh vegetable food or juice the common cause of scurvy, 5150-53; instances given by Dr. Kane, 5153, and Dr. Hayes' winter expedition, 5159, also Lieutenant Beau-

PAVY, FREDERICK WILLIAM, *continued*—

mont's evidence of the value of the seal meat and other fresh meat in curing scurvy, 5153; they having no medicine, 5153; raw meat more efficacious than cooked, 5155-6, 5171; the chemical composition of it being changed, 5157-8; fresh meat induces a better state of nourishment, and ranks next to fresh vegetables in antiscorbutic properties, 5170; food is required for work and for keeping up the bodily temperature, also certain other materials for maintaining health, 5184-5; milk an important article in dietaries, containing all the elements required by the body, 5194-5; alcohol of alimentary value, acting as a carbo-hydrate in addition to its narcotic stimulant powers, 5196-99; it increases the action of the heart, 5200; and the calibre of the vessels, 5201; the increased heat thus developed is counteracted by its escape owing to the warm blood being carried to the surface, 5202; alcohol diminishes capacity for work, but is advantageous in relieving the state of the nervous system induced by exhaustion, and predisposes to sleep, 5204-5; it diminishes the bad effects of over exhaustion and promotes cheerfulness, 5206-7; one ounce is enough to produce its effects, 5208; tea sharpens the faculties and promotes bodily and mental work, 5212; tobacco in moderation is advantageous, 5213; dried vegetables are antiscorbutic, but not so much so as fresh, 5215; greater liability to scurvy under a salt meat diet, 5218; it being deficient in the fresh juice which is specially antiscorbutic, 5219; preserved meat retains the elements of its nutritive properties, but is not in so favourable a condition for maintaining health, 5220; meats are not rendered injurious by being preserved, 5221; but the heat renders them insipid, 5222; monotony of diet renders the food insipid, 5222.

3. Diet on Board—

Advantage of the "Discovery" over the "Alert" in obtaining a considerable amount of game, 5147; importance of considering the difference between the diet on board and sledging, 5148; the more varied diet of the officers protected them from scurvy, 5164-6; the jams may have been antiscorbutic, 5168-9; the dietary on board good, apart from lime juice, 5172, 5180; tobacco should be taken in arctic expeditions, 5214.

4. Diet, Sledging—

Omission in the sledging dietary of food of an antiscorbutic nature, except two ounces of preserved potato, 5148, 5188, 5232; *i.e.*, of vegetables or their substitute, lime juice, 5233; it was a good diet for producing work, not for maintaining the body in a healthy state, 5183-7, 5232; the albuminates, and fat in excess of average dietaries, pemmican being rich in them, 5186; scurvy to be anticipated on such a diet, even if starting in a healthy condition, the potatoes being too small in amount, 5189-90.

5. Lime Juice—

Lime juice the most convenient substitute for fresh vegetables, 5154; a larger allowance of lime juice should have been given on board ship in the recent expedition, 5172-5, 5180-81; the allowance doubled or more at times, 5173, 5181; no fear of prejudicial effect on the digestion or otherwise if two ounces had been given, 5181-2; evaporating it to dryness would destroy its chemical properties and its antiscorbutic value, 5223-4; it would be unsafe to rely on such a preparation to keep off scurvy, 5226-7; if enough heat has been employed to coagulate its albuminous principle, 5227-8; possibility of evaporating it in vacuo, and making it easily portable, 5226-31, 5239-41; to what extent heat may be employed, 5239-42; the sledge party dietary deficient in lime juice, 5233; a daily allowance would have delayed the outbreak of scurvy, 5234; but not averted it, unless a larger ration had been given, 5235; would recommend 2 or 3 oz., if practicable, 5236; prefers lime juice to preserved potatoes, 5237; it should be taken as a whole, without one particular principle being regarded as the active agent, 5242; citric acid proved by experiment to possess antiscorbutic properties, potash not, 5243-5.

6. Sledging, recent Expedition—

Great exertions in autumn sledging, 5147; bright prospects at starting (in spring travelling), 5147.

7. Scurvy—

Scurvy depends on absence of the food belonging to a natural diet, 5150-51; absence of fresh vegetable or vegetable juice the common cause of scurvy, 5152; value of fresh meat as a protective or curative, 5153-9; improvement in sick at Polaris Bay due to fresh meat, they having no medicine except lime juice, 5153-4; scurvy occurs amongst Esquimaux in spite of fresh meat, 5155; immunity of Dr. Hayes's party in December, due to fresh meat, 5159-60; Icelanders suffer from scurvy with a milk and animal diet, 5161-2; and use a vegetable diet as a cure, 5163; variety of diet induces taking more nourishment and more perfect assimilation, 5166-7; immunity of officers in the Austrian army in 1720, 5167; opinion of Sir R. Christison that confinement, inactivity and foul air cannot produce it without dietetic errors, and that these errors will produce it in spite of other healthy conditions of life, 5191; instance of cases with

PAVY, FREDERICK WILLIAM, *continued*—

farinaceous diet, but little meat and milk, 5192; he has not seen a case of scurvy in a person adequately supplied with fresh succulent vegetables, 5217.

8. Health of, and Scurvy in the recent Expedition—

The men of the expedition were picked men in point of health, 5147; underwent great hardships and labour in the autumn without illness, 5147; no scurvy in the autumn, and only one case in the winter, 5147; in the "Discovery," but this proved to be exceptional, 5147; crews apparently in good health on starting sledging, 5147; occurrence of cases of scurvy early in May in "Alert," chiefly men returning from sledging, 5147; occurrence in "Discovery" of men engaged in short sledging, 5148; sketch of outbreak in the northern, western, and Greenland sledge crews, 5148; enumeration of cases, 5148; importance of considering the more severe sufferings of the "Alert," the attack of almost all engaged in long sledging, the comparative immunity of the officers, the difference between the diet on board and sledging, and the absence of scurvy in the autumn sledging and in the winter, 5148; the immunity of the officers due to greater change of diet on board in the winter, 5164-9; extent to which the cases occurring on board may have been due to sledging or to other illness, not to the ship dietary, 5176-9; scurvy to be anticipated with long continuance of the sledge diet even without the effect of confinement in the winter, 5190; the outbreak was caused by the absence of vegetable product in the sledge dietary, 5216.

PIERS, HENRY, Deputy Inspector-General of Hospitals and Fleets. Served in "Investigator."

Subheads 1. General.

2. Diet.

3. Sledging Diet.

4. Lime Juice.

5. Sledging.

6. Scurvy and Health.

7. Ventilation.

1. General—

Served in the "Investigator" from 1849 to 1854, 4442; passed the first winter in the Prince of Wales' Strait, 4445; and left a depot in the Princess Royal Islands, 4446; their winters, where spent, 4480; spent the fourth winter in the "Resolute," 4479; health might be maintained for some time in the arctic with sufficient food and vegetables, 4529-30; young men best fitted for the arctics, 4532; from twenty-one to thirty the best age for a first voyage, 4533; but some up to thirty-five might be taken, 4534; the teetotalers had rather the advantage, 4543; instance of Mr. Court, the master of the "Investigator," a teetotaler, having great power of enduring cold, 4543; his activity in mind and body, 4543-7; is now dead, 4548; what number of abstainers they had, 4684; low temperature experienced December, 1852, 4647-8.

2. Diet—

Scale of diet on board the "Investigator" during first winter, 4447; three quarters of a pound of meat, 4447-8; the crew remained in a good condition after the winter, though they would have liked more, 4449-50; does not consider it was sufficient, 4451-2; more meat necessary, one and a-half pound should be given, 4453-5; reduction of allowance the second year at Mercy Bay to half-a-pound of meat and two-thirds of a pound of flour, 4456; crew suffered from want of sufficient food, 4458, 4462; a considerable quantity of fresh meat obtained the second winter, 4459, 4607-8; and some the third, 4539; chiefly reindeer, hares and ptarmigan, 4540; not so much game got 1852-3, men being too weak to hunt, 4637-41; about a pound a-day, 4460; in the spring of 1851-2, had fresh meat about once in ten days, 4600; reduction the second winter in Mercy Bay in vegetables and lime juice, 4482; injurious effect of reduction on health of crew, 4508-10; this dietary remained in force till they left, 4652; placed on full rations on arriving at "Resolute," 4483, 4653-4; much sorrel but little scurvy-grass obtained in "Investigator," 4541; what sorrel they got, recovery of scorbutic cases under it, 4619-26; its taste an agreeable sub-acid, 4620; it was obtained only in 1852, 4646; not much mustard and cress grown, 4542; salt meat should be avoided as conducive to scurvy, 4555-6; the supply of vegetables in 1851 not liberal, 4592-7, 4601; doubts their having cranberries, 4593; the actual quantity of vegetables far short of the nominal, 4593; four ounces not equal to more than one and a half really, 4595; vegetables preserved in fluid preponderated, 4596; list of vegetables taken in former expeditions, 4677; found Edwards's potato very good, 4678-9; not much fault to find with diet of recent expedition, three quarters of a pound of preserved meat small, the allowance of vegetables fair, 4677; men latterly did not care so much for their rum, 4685; it might be dispensed with in arctic service, 4686.

3. Diet, Sledging—

Preference for tea over rum, 4536; would take both tea

PIERS, HENRY, *continued*—

and cocoa, 4537; prefers cocoa to tea as having more nourishment and warmth, 4537-8; tho "Investigator's" diet, biscuit and oatmeal, 4575; no potato, 4575-6; not sufficient fuel for cooking, 4576; small amount consumed on one expedition, 4576, 4584; owing to want of fuel to cook, 4584; no fresh vegetables obtained, 4587; no bacon, onion powder, or surry paste taken, 4674; the sledging ration in the recent expedition not liberal, 4673; the allowance of vegetables small, 4674.

4. Lime Juice—

When it was issued in "Investigator" the men were seen to take it, 4511-12; the ration was one ounce, 4598-9; is sure it was taken, 4600; reduction to half an ounce of lime juice in "Investigator," 4482; in October, 1852, 4507, 4612, 4627-9; reduction conducive to weakness of the crew, 4508; a liberal allowance in "Resolute," 4484; citric acid in crystals supplied instead when sledging, 4513-14, 4517, 4580, 4582-3; believes lime juice was not sent, 4522-3, 4578-9; citric acid was a medical article, not a ship's store, 4516; was sent as an antiscorbutic, 4681; very inferior to lime juice, 4515; but has some prophylactic property, 4590; very weak, 4681; it required mixing with water, 4518; they had a very small proportion of it compared to lime juice, 4519; it was sent for use of the men as a drink, 10 dose prescribed, 4581; does not attribute health of sledge parties to it so much as to condition of men in starting, 4588-90; it was not used as a curative of scurvy on board, 4682; it is an advantage to take lime juice sledging, but well trained men might go through a long journey without it, 4553-4; scurvy in "Investigator" might have been retarded if not avoided had the full ration of lime juice been maintained, 4658; the effect of lime juice would not last long after its discontinuance, and the blood would deteriorate, 4670; the attack in the late expedition would have been delayed had lime juice been taken, 4687; is not prepared to say it would have been so sledging, 4688.

5. Sledging—

Was engaged on sledge journeys, 4443; in leaving the "Investigator" and joining the "North Star," 4444; a considerable amount of sledging done after first winter, 4463; after the second winter, no sledging done, except to Melville Island, 4466-8, 4613; abandonment of the ship; journey to "Resolute," 4471, 4474, 4559-62; men worked well with improved prospect, and the sledges light, 4474-5, 4478; travelled 9½ hours without tenting, 4478; previous to abandoning the ship he had not sledged, but had been away shooting, 4570; the longest journey from "Investigator" was in 1851 for forty days, 4571-2.

6. Scurvy and Health—

Crew of "Investigator" in good health at the end of the first winter, 4449-50; in spite of limited diet, no scurvy in 1851, 4591; no scurvy in sledge expeditions in 1851, 4577, 4586; immunity due rather to condition of men on starting than to citric acid, 4588-90; injurious effect of want of food the second winter, 4457-8, 4462; no scurvy before sledge journey in 1851, 4572-3; condition of the men on return from sledging, after the first winter, very good, 4464-5; deterioration of health of crew at the end of the second winter, 4469, 4602; after reduction of rations, 4602-4; scorbutic signs shown in the spring, 4470, 4605; scurvy appeared in May, 1852, 4471; and existed before abandoning the ship, 4569; some suspicion of it before, 4605; increased after May, 4606, 4616; incapacity of some men to drag on journey to "Resolute," 4471-2; their complaints, to what extent affected with scurvy, 4473; almost all the men affected on leaving the ship, 4650; reduction in lime juice and provisions conducive to weakness in 1853, 4508-9; with a larger ration of provisions, there would have been less disease, 4510; improvement on board the "Resolute," 4476, 4651; attributable to increase of nourishment, lime juice and fruits, 4477, 4483-4, 4489, 4527; and prospect of getting home, 4489, 4527, 4651-5; a great many went on the sick list, 4484; but they gradually recovered in the winter, 4485; two deaths occurred; the others recovered wonderfully, 4486-7; on reaching Beechey Island, the health was much improved, 4488; scorbutic symptoms in all his party on journey to Beechey Island, 4558-67; insane appearance, 4563; flying pains before leaving the ship, 4567; four deaths in the "Investigator," 4524; none till April, 1853, 4618; three then from scurvy, 4634; death of Mr. Sainsbury on board the "Resolute" in November, 1853, 4524-6; from consumption, 4656; advantage of keeping men hopeful, 4528; insanity of one officer, probably the effect of the voyage, 4549-50; imbecility of one man, due to climate and insufficient food, 4551-2; the sick list rarely exceeded, in 1852, twenty out of sixty-five, 4617; what the largest number was in 1853, 4635-6; improvement of men under sorrel (1852), 4619-25; would have got rid of the disease if it had continued, 4624; scorbutic taints predominant in the large amount of sickness (1852-3), 4630-31; and decided

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scurvy, 4632-3; inability of men to hunt in winter (1852-3), owing to debility and depression, 4637-41; their symptoms, 4642-5; diarrhoea in December, 4647; the scurvy due to want of food, primarily of vegetables, 4657; symptoms (and effusions) observed, 4683; the outbreak in the recent expedition to be sought for in the ships before sledging, 4557, 4667; immunity from scurvy to be expected with good food and lime juice; condition of blood gradually deteriorates on lime juice ceasing, 4670; does not attach much importance to absence of light, which is not very depressing, 4675; but the cold favours production of scurvy, 4675; belief of its being in the men before they left the ship, as it broke out so very soon, 4689; modification of this opinion, considering that the men were examined and found healthy before leaving, 4690.

7. Ventilation—

Ventilation in "Investigator," a Sylvester stove and metal ventilators as uptakes, through the deck and awning, 4490-91; downtakes by the hatchways only, 4492-3, 4660; there was a hatchway for the men forward, 4661-3; much drip from the beams of the upper deck, constant wiping, 4494; condensation froze, even in cabins, 4497; not enough dripping to wet men's blankets, 4496; in some of the officer's cabins the moisture dripped, 4497; no opening from the Sylvester stove into his cabin, 4498; nor fresh hot air, 4500; believes it did not admit fresh air, 4664; but warmed the air in the ship, 4665; advantage of introducing heated air, 4666; only one hatchway used, 4501-2; extent to which this was housed over, and what doors there were, 4503-6; they never suffered, owing to ventilation, 4659.

PULLEN, WM. J. S., Rear-Admiral, formerly in the "Plover" and "North Star."

Subheads 1. General.

2. Diet on Board.
3. Diet, Travelling and in Winter Quarters.
4. Sledge Diet.
5. Lime Juice.
6. Sledging and Boat Journeys.
7. Scurvy and Health.

1. General—

Stations of Hudson's Bay people at Fort Simpson, and the Great Slave Lake, 6142-5; the men were half-breeds, 6146; the officers Scotch, 6146; a small patch of ground at Fort Simpson cultivated, 6137, 6147; potatoes, barley and turnips grown, 6148-9; service in the "North Star," from 1852-54, 6203; dangerous position of the ship when driven on shore, 6210; the "North Star" had two decks, the main deck used for berths, the lower for work, 6215; advantage of this, 6216; men employed as much as possible, besides instruction, 2615; the warming was by a Sylvester stove, and stoves, 6217; the ship was damp (whilst on shore) when on her broadside, but the dampness was cleared off when upright, 6218.

2. Diet on board—

Diet on "North Star," much the same as in recent expedition, 6207.

3. Diet, Travelling—

On Boat Journey—

Was preserved meats, pork, beef, potatoes, vegetables, biscuit and flour, 6090-94, 6123; a good deal of potato used nearly every day, 6124-6; found fuel on shore, 6095; his provisions thrown overboard on account of or damaged by bad weather, 6097; nothing left on arriving at Fort Simpson, 6097-9; his potatoes and vegetables were exhausted before he reached Fort Simpson, 6128-30.

Diet in the Winter quarter—

At the Forts was dried deer meat and fish, being dependent on the hunting by the Indians, 6103, 6137, 6154; no bread, 6104; no vegetable food, 6188-9; daily allowance was of dried deer meat four pounds, 6105; of fish (a kind of bream), four fish, from eight to ten pounds, 6105, 6119; herrings at the Great Bear Lake, 6191; pemmican, two pounds, 6105; the men with him had only their allowance, 6139-40; he lived with Dr. Rae, whose kindness was very great, 6105; one fish day a week, the rest deer or bear flesh, 6105-7; two geese or four ducks the allowance when obtained, 6110; no vegetable food except potatoes for himself in Dr. Rae's mess, 6106, 6137; and some flour sent to Dr. Rae as a chief fur trader, 6107, 6137, 6150; believes barley was also grown, of which he got some, 6137, 6150; the drink was only water, 6108-9; no tea, 6110, 6157; the men not with him lived entirely on fish, 6119-20, 6133-6; at the Great Bear Lake on fish, varied by dried meat and pemmican occasionally, 6133; only occasional meat got by the hunter, 6134-6; on the Great Slave Lake got trout of eighty pounds, 6133; fresh meat and bread obtained on the way home, 6110; some men of the Hudson Bay service capable of eating large quantities of meat, 6151-2; twenty pounds a day eaten by one man, 6151; there were no vegetables, 6154; the meat was eaten well cooked, 6155-6; he got a little tea with Dr. Rae, 6157; no spruce beer was made, 6158; he had a little spirits the second year, but not enough

PULLEN, WILLIAM J. S., *continued*—

for the men, 6160; lived on this diet from 3rd October, 1849, to June, 1850, 6187; his men preferred meat to fish, 6190.

In 1850, in boat journeys, diet dried meat and pemmican, 6113, 6172; an Indian hunter with them, 6113-13; got some fresh deer meat which was eaten well cooked, 6172-4; found some mushrooms, 6173; the pemmican was made in England, some had currants and sugar, but the plain was preferred, 6175-6; in winter quarters, 1850, found some flour and pemmican, 6119.

4. Sledge Diet—

Diet sledging same as on board ship, but more preserved meat and pemmican, and Moore's chocolate, 6221-2; list of sledge provisions, 6230-32, 6235; seldom took spirits, but made tea, 6242; his men took their rum in the daytime and smoked at night in their bags, and did not want spirits, 6243.

5. Lime Juice—

No lime juice taken in boat journeys, 1849-51, 6096, 6162; not considering it necessary with preserved meat and vegetables, 6162; had never met with scurvy, 6164-5; has travelled in Australia on meat diet without it, 6166; it is the custom at sea to give it after fourteen days' salt provisions, 6193; as an antiscorbutic, 6195; considers it should be taken, but does not remember issuing it in the arctics, 6200; the difficulties of thawing lime juice would prevent taking it, he never took it sledging, 6202-3, 6223, 6232; it was only occasionally issued in the "North Star," 6207-8; was drunk mixed at the tub, 6209.

6. Sledging and Boat Journeys, &c.—

Enumeration of sledge and boat journeys, 6086, 6219-20; boat journey from "Plover" to and up the Mackenzie River, to Fort Simpson, 1849, 6087; from thence to Cape Bathurst and back in 1850, 6087; return to England, 1851, 6087; had fourteen men and two five-oared whale boats, 6089; all English sailors of the "Plover," 6184-5; experienced heavy gales, and was obliged to throw food overboard, 6097; his party in winter of 1849-50 distributed between Forts Simpson and Macpherson and the Great Slave Lake, 6097, 6119, 6127-32; some at the Great Bear Lake in Franklin's old fort, which they repaired, 6119; a hunter and a fisherman being with them, 6119; they could not find provisions without dividing the parties, 6132; the arrangements were made by Dr. Rae, 6132; left Fort Simpson 11th July, 1850, and returned to it 5th October, 6114, 6169, 6177; what men he had, 6171; hard work and heavy ice encountered in journey to Cape Bathurst, 6180; heavy work sledging across Wellington Channel, 6225-27; had to unload the sledge, 6226; weight, 193½ lb. per man, 6228; statement of equipment of sledge, 6230; the ice in his sledge journeys very heavy and hummocky, the standing haul often necessary, 6237; soft snow where the hummocks were piled up, 6238; the ice of the recent expedition must have been heavier, 6239-40; the cold was against them, 6239.

7. Scurvy and Health—

No scurvy in his boat expedition from "Plover," in spite of exposure and absence of vegetables, 6087; one man was not well at starting, but would not go back, 6101; but had no scorbutic symptoms, 6102; they were in very good health, 6161; had no doctors nor medicine, 6161; the men gave no signs of sickness the second year, and volunteered to search the coast again, 6112; health of crew on return very good, he himself sick after eating, and had diarrhoea, 6116-17, 6178-9; healthy in spite of hard work, 6180-81; no scurvy appeared, 6119; has never met scurvy, 6195; it was unknown at the Hudson Bay stations, 6144, 6197; immunity due to hard work, good air and fresh provisions, 6199; Esquimaux do not have scurvy, their diet, fresh meat without vegetables, 6196; outbreak in recent expedition possibly due to the necessary confinement, 6201; health of crew of "North Star" bad, but not from scurvy, from the difficult position of the ship, 6210; and hard work, 6211; changed the crew when the "Phoenix" arrived, 6212; no symptoms of scurvy the end of the second winter, 6214; no suspicion of scurvy when sledging, 6234, 6241; conditions of his journeys the same as of the recent expedition, and cannot account for his immunity, 6242; personal sufferings when sledging, from snow-blindness and rheumatism, 6243.

RAE, JOHN, M.D., F.R.G.S.

Subheads 1. General.

2. Diet.

3. Health.

4. Lime Juice.

5. Scurvy, Causes of.

6. Scurvy, Instances of.

7. His Sledging and Boat Journeys.

8. Sledges, Sledging, &c.

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RAE, JOHN, *continued*—

References to—

Admiral Pullen—

His kindness, he shared what luxuries he had, 6105-7.

Sir G. Nares—

Inability to drag his boat, 9340.

1. General—

Formerly a Surgeon under the Hudson Bay Company, 8700; served in Franklin searching expeditions in 1848-49 and 1850-51, 8701; there is a garden at York Factory, 8795; nationalities of the men on his expeditions, 8726; nationalities of men in 1850 journey, 8739; they were good boatmen and fit for any work, 8737-8; nature of the work done by the men living on the large meat diet, pretty hard work, but not severe, 8830; Esquimaux all live in the same house and sleep together, 8747; their friendliness to him and honesty, 8747; disbelief of their having injured Sir J. Franklin's expedition, 8747; they remove their coats when asleep, and lie close together to maintain heat, 8841; their snow huts, method of building and arrangements in them, 8844-5; they object to glazing their huts, or using ice in their construction, as ice is a better conductor of caloric than snow, 8844-5; no warming, except by an oil lamp, 8846; what the cubic space is for six or eight persons, 8847-8; the air not impure, the snow being porous enough to admit air through without draft, 8850; enough light comes through the walls to see to read or write, 8851; suspected cannibalism amongst them, 8861; no indication of scurvy amongst them, 8862; or phthisis, 8867; their diseases principally influenza, 8866.

2. Diet—

In the Hudson Bay service, tea is never issued, but can be bought, 8715; at Red River they get vegetables and flour, 8740; but in more out-of-the-way parts none, 8740-41; they got a few berries occasionally, 8741; method of making pemmican by the Hudson's Bay people, 8772; description of the service berry, sometimes put into it, 8772-5; he and his men could always eat more than their ration of pemmican, 8778; the children's rations at the Great Bear Lake, two pounds of meat a day, 8710, 8784; in absence of vegetable or flour, the system requires a great deal of meat, one pound of flour with two or three pounds of meat found to equal eight pounds meat alone, 8784; ration of meat diminished when other food was given, 8794; the reindeer stomach, with its contents, eaten by the Esquimaux and hunters, 8786-9; what the contents and the taste are, 8863-5; thinks he did not himself eat eight pounds of meat a day, 8790; has heard of sixteen pounds being eaten, 8791; in the Saskatchewan, potatoes, if any, are given, in addition to eight pounds of meat, 8792-3; the ration where he stayed, five or six pounds of goose and one pound of flour, and with potatoes less flour, 8801; rations of spirits not given in Hudson's Bay territory, 8808; even to officers, owing to desire of keeping it from the Indians, 8809; men, even if fond of spirits, would not take it before the work was done, 8810; bad effect of rum in a cold climate, 8836; recommends abstinence from it, 8872; details of diet when sledging, tea for breakfast and supper if possible, 8806; pemmican eaten cold in the morning, cooked at night, 8806; no spirits taken, except for fuel, 8807; as a medicine, or to give occasionally, 8873-4; it was popular when given, 8874; it is not necessary on sledging parties, 8875; they lived for six or eight months without vegetables or farinaceous food, 8817; what is obtained travelling in the summer, 8818; fir tops were not eaten, nor spruce beer made in his journeys, 8823-6; spruce beer made when scurvy broke out in 1833-34, 8825; objection to tea in the middle of the day, on account of the halt, 8841; to what extent vegetables were cultivated round the forts of Hudson Bay people, 8868-71.

In Sir J. Richardson's expedition, 1849-9—

During winter at Great Slave Lake chiefly fish, 8709; rations allowed at the Fort, eight pounds fresh venison a day per man, or three large white fish, 8710, 8779, 8828; including bone, 8781; twenty-five pounds of flour for the winter, 8710-12, 8716; no tea or very little, 8711-15; or biscuit, 8713; or spirits, 8714; the meat was boiled rather underdone, but never raw, 8732-3; Sir J. Richardson and the officers lived on the same diet, with a little more flour, 8832-3; the men had no longing for vegetables, but he had for cranberries, 8835.

In Journey 1845-46—

Lived on reindeer in the winter, 8722; diet when sledging one and one-third to one and a half pounds of pemmican, one-third pound of flour a day and seal meat, in second expedition tea, chocolate, and sugar, and some game got, no spirits given, 8722; the ration not enough, 8723; no vegetables for fifteen months, 8819-21; drank tea, chocolate and water, 8822.

In 1850—

Shot some game, 8735; lived chiefly on deer and half a pound of flour a day and a little pemmican, 8744; little spirits or tea, 8746; in 1853-4, statement of what winter diet at Repulse Bay was, 8747; venison *ad libitum*,

RAE, JOHN, *continued*—

no spirits, cooked only once a day, 8747; list of diet in spring sledging (pemmican, flour, preserved potato and condensed milk), 8747; extract of tea prepared by Dr. Bence Jones found very useful, 8747; but little game obtained, 8747.

At York Factory—

Chiefly salted meat, obtaining venison not being certain, preserved potatoes and cranberries issued in its absence, scurvy occurs under salt meat diet, 8791-800, 8815-16.

Of the Esquimaux, 8852-60; their preference for musk ox, 8852-3; and venison, 8853; method of obtaining fish, 8856; and spearing salmon, 8856; to what extent whale and seal is eaten, 8857-60; white whale kept in store at Fort Churchill for half-domesticated Esquimaux, 8860; they eat reindeer stomach, 8862.

3. Health—

Men of Sir J. Richardson's expedition (1848-49) healthy after a winter on solely carnivorous diet, 8717, 8721, 8829; the men who lived on fish looked healthier, but were not so wiry as those who lived on meat, 8829.

In 1845-46—In his sledging expedition, the men had improved in health on return, 8722.

In 1850—Health excellent, 8736; reached Minesota in perfect condition, men taking care not to overwork themselves, 8746.

In 1853-54—Men perfectly sound, except one man suffering from frost-bite, 8747.

4. Lime Juice—

The Hudson Bay Company only kept it at York Factory, because there are no vegetables and the diet is chiefly salt meat, 8759; suggestion to carry it in flat tin bottles, 8761; had but little lime juice when the outbreak of scurvy he witnessed occurred, 8768-71; lime juice might have delayed or mitigated the outbreak in the late expedition, 8886-7.

5. Scurvy, Causes of—

Cannot account for immunity of Hudson's Bay people with meat diet, 8836; but is possibly due to absence of spirits, 8836; the scurvy in the cases he saw could have been prevented by cranberries, 8839; it is a blood disease caused by deficiency of something got from vegetables or their equivalent, 8876; cold, fatigue, &c., would not alone produce it, 8877; fruit will cure it, 8878; immunity in his expeditions due to men being accustomed to the work, and not dragging very heavy loads, 8884; the outbreak in the recent expedition possibly due to too little exercise, 8841; the double allowance of grog, and the increase and then stoppage of lime juice bad, 8841; also stopping for tea in the middle of the day, thus causing stagnation of blood, 8841; also sheltering in tents, 8841; perhaps to overwork at first, 8885.

6. Scurvy, instances of—

Instance in a Hudson's Bay ship in 1833, of which he was surgeon, and which wintered at Charlton Island, 8748; diet of salt pork and beef, salted geese, biscuit and flour, little fresh food, lime juice or rum, spruce beer made, 8748, 8765; no vegetables, except frozen potato for the sick, 8766, 8771; fifteen or sixteen cases out of thirty persons, their symptoms, death of captain and first mate, recovery of the rest on cranberries and vetch, after exhaustion of lime juice, 8748-52; the men of the Hudson's Bay service very little affected, the crew and passengers chiefly attacked, 8749-50; but little lime juice given, and that not regularly, 8768-71.

In the Hudson's Bay Service—

Scurvy only appears at York Factory, owing to diet being chiefly salt meat, 8794-8800, 8815-16; preserved potato and cranberries issued when there is not enough fresh meat, 8796-7; the scurvy generally appeared in absence of fresh venison, 8816; none occurred in his sledge journeys, 8883.

7. His Sledging and Boat Journeys—

Principal sledging experience was in Hudson's Bay service, 8702; journey with Sir J. Richardson, 1848, in boats down the Mackenzie River to the Coppermine, 8701-5; wintered at the Great Bear lake, 8706-7; journey in boats for Hudson's Bay Company along Hudson's Bay in 1845, wintered there, using reindeer skins as clothing and having but little fire, sledged in the spring on Boothia and the Melville Peninsula, ice in the latter journey too rough for sledging, built snow houses and took only blankets, absent fifteen months, 8722-4; journey in 1850 along Wollaston Land after wintering at Fort Confidence, where he built boats during the winter and rigged them himself, 8727; his journey, 8730-32; reached Cape Baring close to "Investigator," but obliged to return owing to the thaw, 8736; details of return late in the year, and from Fort Confidence to Minesota, travelling on snow shoes, 8746; journeys in 1853-54 to Boothia, wintered at Repulse Bay in snow houses, he lived alone and therefore was colder than the others, imparted instruction to his men, sledged in the spring, and brought home the first information about Sir J. Franklin, 8747.

8. Sledges and Sledging—

Description of his sledges, 8728-9; do not sink in deep snow, as those in the recent expedition did, 8728-9;

RAE, JOHN, *continued*—

advantage of his sledge in enabling greater distance to be travelled, 8842; objection to the recent Government sledge for hummocky ice, 8881; in 1847 used the high runner sledge, but iced the runners, 8729; the weight for a dog 100 lbs.; for a man 150 lbs.; an Indian woman with snow shoes known to haul over 200 lbs. fresh meat at ten or twelve miles a day, 8731; took dogs on two of his expeditions, 8802; dogs useful with smooth ice, 8803; but are difficult to get on in bad ice, 8803-4; he travelled ten hours a day, and never stopped; details of arrangements of the day's journey and camping, 8806; he practised his men before starting, 8885; made pretty long journeys, even at first, 8885; was occasionally detained by bad weather, 8811; the halts may have been a relief, but not generally, 8813; the work of the recent expedition exceptionally hard, owing to exceptionally soft snow and rough ice, 8841; their constant weights too large, 8841; comparison of nature of work in his and their journeys, 8879-82; doubt whether anything could be worse than some he encountered, 8881; the weight in the northern party too large, 8882; snow shoes; account of different sorts, 8754; advantage of taking them, 8755; they would have rendered the work in the western and eastern journeys of the last expedition easier, 8879-80; objection to tents, as heavy, and causing condensation of moisture, 8841; and to sleeping in blanket bags, as separating the heat of the different bodies, 8841; he took only 40 lbs. constant weight, and his men lay together, 8841; preference for snow houses over tents, as warmer healthier, and preventing the bedding getting frozen, and saving dragging weight, 8841-2; method of making them, 8841; time taken to do so, 8842; no moisture in these snow huts, 8843.

RAWLINGS, THOMAS, Captain of Forecastle.

Subheads 1. General.

2. Diet on Board.

3. Diet Sledging.

4. Lime Juice.

5. Scurvy and Health.

6. Sledging.

7. Ventilation.

1. General—

Captain of forecastle of "Alert," 7621; was captain of a mess and of Captain Markham's sledge, 7623; previous service, 7626.

Exercise—

The sledge crews were practised dragging loads before spring travelling, 7639-42; all the travellers were trained, 7714-15; 7816: the training was useful, 7818; the work not so heavy as in actual sledging, 7817; at least two hours' exercise outside compulsory, 7717-28, 7810-13; in addition to exercise on upper deck, 7721-22; and was taken even in bad weather, 7719; most of the crew on deck or outside during the whole day, 7727, 7811; what the work and exercise was, 7811; it was taken, even in very cold weather, 7813-14; sufficient was taken, 7815.

2. Diet on Board—

The salt beef not so good as usual, 7628, 7669-71; the pork and other provisions very good, 7628-9, 7672-3, 7690-91; appetites fell off in the winter quarters, 7631; some of allowance not drawn, 7632; had as much food as he could eat, 7674; salt meat disliked from fear of scurvy, 7680; it was not taken up, being dry and hard, preserved meat of previous day made to last two days, 7683-9; vegetables given every day, 7693, 7698; they were liked, 7694-5; routine in which given, 7700; potato three times a-week, 7697; as much as they could eat, 7701-3.

3. Diet, Sledging—

Men worked better after lunch of tea and bacon than in the morning, 7662-3; rum taken at night, 7664; and liked then, 7759-63; assists going to sleep, 7664, 7759-63; preference for tea at luncheon, 7665; appetites good, and full allowance eaten, 7734-5; it was sufficient, 7737; and enough potato, 7733-41; the pemmican was liked, 7736; preference for sweet pemmican, 7757-8; the tea was liked, 7851; and was hot when drunk, 7852; in autumn sledging, the only difference was taking preserved meat instead of pemmican on a short journey, 7704-8; and six ounces of bacon, instead of four in spring, 7751-6.

4. Lime Juice—

Lime juice taken on northern sledge party as a medical comfort, 7666-8; did not miss it sledging, 7742; every one obliged to take it on board, 7744; the extra allowance in March was sent to the messes, was liked and generally taken, 7746-9.

5. Scurvy and Health—

Could not have wished for a better crew, 7661; health good in autumn sledging except frost-bite, 7709-10; felt in perfect health before spring travelling, 7638; the men started well and worked well, 7729-32; and were well when supporting sledges left, 7733; were very eager to push ahead, 7729; scurvy, date of attack, walked

RAWLINGS, THOMAS, *continued*—

till relief came, 7658-9; symptoms in his case, 7675-9; no fear of it existed when starting sledging, 7681; illness of Shirley on twelfth day, but after supporting sledge had left, 7764-6; symptoms of persons attacked, 7772-84; five men carried on sledges before return, 7785; their sufferings in crossing the hummocks, being lashed on to the sledges, 7830-31; every one ill before relief came, 7789; measures for relief, 7787-91; treatment, 7791-7, 7807; the worst cases in cots, the rest on deck, 7798; extreme attention of Dr. Colan, he himself did extremely disagreeable nursing, 7799-7807; and was made ill by overwork, 7808-9

6. Sledging—

What sledging he did, 7624; in autumn, double banking and unloading necessary, owing to heavy snow and land travelling, 7647-52; in spring, double banked soon after starting, 7614-5; the snow being very heavy, 7645; unloading not necessary, 7653; the weights, 200 pounds in autumn, 240 pounds in spring, 7646; the three sledges advanced one at a time, 7655-7, 7827; some men employed road making, 7655-6; one boat left behind, 7654; men pretty well done up at night, 7762; spring travelling heaviest, partly owing to leaving the land, 7767; and the hard work necessary in road making, 7767-8; two boats taken, 7770; no man dragged more than 240 pounds at a time, 7771; weights did not increase after men fell ill, because the boats and provisions were left behind, 7786; the work, sledging, the hardest he has ever done in the service, 7819-20; being incessant, 7821; difficulty of walking and dragging in the heavy snow, 7821; often unable to go round the hummocks, 7821-5; their height about fifteen feet, 7824; arrangements for getting sledges over, 7829; arrangements for cutting roads and advancing sledges, 7824-9; and walking in deep snow, 7833-4; the road made whilst sledges were being packed, 7827; the weather foggy on return, 7835; had to encamp for three days at different times on account of weather, 7836-8; readings by Captain Markham during this time, 7839; travelled by night to avoid the sun, 7840-42; wore green-glass goggles, 7843; time taken to encamp and get meals ready, 7845-6; duty of cook taken in turn, 7847; what his duties were, 7848; took about three hours at night, 7849; no man frost-bitten whilst acting as cook, 7850.

7. Ventilation—

The "Alert" had more room than any ship he had served in, 7625; the berthing as good as in any other ship, 7633-4; the bedding always dry, 7635; and was aired, 7637.

RAWSON, WYATT, Lieutenant R.N.

Subheads 1. General.

2. Diet.
3. Lime Juice.
4. Sledging.
5. Scurvy.

Reference to—

Dr. Coppinger—

Worked hard sledging, but was exempt from scurvy, 2973.

Commander Beaumont—

Dragged all the way, 971.

1. General—

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RICHARDS, GEORGE HENRY, Rear-Admiral, C.B., F.R.S., served in "Assistance," 1852-54.

Subheads 1. General.

2. Diet on board.
3. Diet sledging.
4. Lime juice.
5. Sledging, general, former, and recent expeditions.
6. Scurvy and disease.
7. Ventilation.

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7. Ventilation—

Recent Expedition—

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General—

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ROBERTSON, JOHN, M.D., Deputy Inspector-General of Hospitals and Fleets, formerly of the "Enterprise," 1848-49. Letter at page 316.

Cause of personal attack of scurvy due to confinement in consequence of an accident; his symptoms; his recovery, and that of other cases, is due chiefly to supply of sea birds; mode of preparing them, and their use as soup with potato and oatmeal; oatmeal and potato good antiscorbutics; the lime juice supplied contained only one-

ROBERTSON, JOHN, *continued*—

tenth of its proper proportion of acid; the ship had plenty of vegetables and fruits; exercise; three or four ounces of lime juice, and plentiful mixed nourishing diet, good treatment; what the clothing in the arctic regions should be; there was no regular outbreak of scurvy, but some cases returning from the sledging showed a tendency to it; no deaths occurred.

SCOTT, CHARLES ROBERT, Fleet Surgeon, R.N., served in "Intrepid."

Subheads 1. General.

2. Diet.
3. Diet, Sledging.
4. Lime Juice.
5. Sledging.
6. Scurvy, Health.
7. Ventilation.

1. General—

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2. Diet—

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3. Diet, Sledging—

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4. Lime Juice—

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STEPHENSON, HENRY F., C.B., Captain R.N.

Subheads 1. General.

2. Diet on board Ship.
3. Diet Sledging.
4. Lime Juice.
5. Selection of Men, Medical Examinations, Health.
6. Routine of the Ship, Exercise, Recreation.
7. Sledging.
8. Ventilation, Warming, &c.
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Medical instructions for officers in command of sledge parties	12
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TOMS, FRANCIS Y., Fleet Surgeon R.N.

Subheads 1. General.

2. Diet on Board.

3. Sledge Diet.

4. Lime Juice.

5. Sledging.

6. Scurvy, and other Diseases.

7. Ventilation.

1. General—

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WOOD, WILLIAM, Color-Sergeant, R.M.

Subheads 1. General.

2. Diet on Board.
3. Diet, Sledging.
4. Lime Juice.
5. Scurvy and Health.
6. Sledging.
7. Ventilation and Accommodation.

References to—

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2. Diet on board—

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3. Diet, Sledging—

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5. Scurvy—

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YOUNG, ALLEN, Captain, served in the "Fox."

Subheads 1. General.

2. Diet.

3. Diet, Sledging.

4. Lime Juice.

5. Sledging.

6. Scurvy.

1. General—

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3. Diet, Sledging from the "Fox"—

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4. Lime Juice—

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5. Sledging—

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GENERAL INDEX.

The remarks (not of a general nature) of officers who served in former expeditions refer in most instances, or unless otherwise specified, to their own expeditions. The expeditions served in are shown in the Analysis of Evidence, marks in the Alphabetical List of witnesses denote those who served in former and the recent expedition, and a List of the Ships served in by such Witnesses is given at page 413. The remarks, not general, of other witnesses, in almost all instances, refer to the recent expedition.

The "Assistance," "Resolute," "Enterprise," "Investigator," "Pioneer," "Intrepid," and "North Star," served in two expeditions.

ABSTAINERS. [See also *Spirits*.]—

Sir G. Nares—

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Commander Aldrich—

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Dr. Colan—

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Dr. Colan—

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Dr. Moss—

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Dr. Ninnis—

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Dr. Copping—

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Admiral Richards—

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Sir L. M'Clintock—

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Dr. Toms—

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Dr. Lyall—

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J. Organ—

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Dr. Barnes—

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ACIDS. [For *Carbonic Acid*, see *Air*.]—

Dr. Colan—

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Dr. Moss—

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Dr. Piers—

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Dr. Macdonald—

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Dr. Pavy—

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Dr. Buzzard—

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Dr. Dickson—

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ACCOMMODATION ON BOARD SHIP. [See *Ventilation*, *Air*.]

AGES OF MEN. [See *Men*, selection of.]

AIR. [See also *Ventilation*.]

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4. Officers'.

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Dr. Ninnis—

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Dr. Coppinger—

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Dr. Piers—

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Dr. Macdonald—

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Dr. Guy—

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Dr. Buzzard—

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Mr. Leach—

The Americans use vegetables and molasses, not lime juice, as antiscorbutics, 5574-5; molasses are valuable, but not convenient for stowage, 5577; the antiscorbutic virtue in dried vegetables and preserved potato not yet ascertained,

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5597; scales of vegetables, convicts and merchant seamen, 5597.

Dr. Dickson—

Pork much relished by seamen, and very nutritious, it should be issued with preserved meat, 5662; molasses an antiscorbutic and good with pork, 5715-16; but molasses and potatoes not better than lime juice, 5716; cranberries and tamarinds good antiscorbutics, 5719-20; but not better than lime juice, which keeps better 5720; valuable properties of unripe apples, 5722; dietary recommended for the merchant service, 5663.

Vice-Admiral Ommanney—

Raw potato and cognac given by the French as antiscorbutic, 5899.

Captain Feilden, R.A.—

With General Beauregard, no lime juice, but vegetables, 6080; potatoes and molasses, 6081-3.

Rear-Admiral Pullen—

On Boat Journey—

Preserved meats, pork, beef, potatoes, vegetables, biscuit, and flour, 6090-94, 6123; a good deal of potato used nearly every day, 6124-6; found fuel on shore, 6095; his provisions thrown overboard on account of or damaged by bad weather, 6097; nothing left on arriving at Fort Simpson, 6097-9; potatoes and vegetables were exhausted before he reached Fort Simpson, 6128-30.

Diet in the Winter Quarter—

At the Forts dried deer and fish, being dependent on the hunting by the Indians, 6103, 6137, 6154; no bread, 6104; no vegetable food, 6188-9; daily allowance was of deer four pounds, 6105; of fish (a kind of bream), four fish, eight to ten pounds, 6105-10; herrings at the Great Bear Lake, 6191; pemmican, two pounds, 6105; the men with him had only their allowance, 6139-40; he lived with Dr. Rae, whose kindness was very great, 6105; one fish day a week, the rest deer or bear flesh, 6105-7; two geese or four ducks, the allowance when obtained, 6110; no vegetable food except potatoes for himself in Dr. Rae's mess, 6106, 6137, 6154; and some flour sent to Dr. Rae, 6107, 6137, 6150; barley also grown, of which he got some, 6137, 6150; the drink was only water, 6108-9; no tea, 6110-57; men not with him lived entirely on fish, 6119-20, 6133-6; at the Great Bear Lake on fish, varied by dried meat and pemmican occasionally, 6133; occasional meat got by the hunter, 6134-6; on the Great Slave Lake, trout of eighty pounds, 6133; fresh meat and bread obtained on the way home, 6110; some men of the Hudson Bay service capable of eating large quantities of meat, 6151-2; twenty pounds a day eaten by one man, 6151; the meat was eaten well cooked, 6155-6; he got a little tea with Dr. Rae, 6157; no spruce beer was made, 6158; a little spirits the second year, not enough for the men, 6160; lived on this diet from 3rd October, 1849, to June, 1850, 6187; his men preferred meat to fish, 6190; in 1850, in boat journeys, diet dried meat and pemmican, 6113, 6172; an Indian hunter with them, 6113-15; got some fresh deer meat, ate it cooked well, 6172-4.

Dr. Barnes—

Recommends more potatoes and fruit and modification of the vegetables, 7054; scurvy would not occur for a year, under this modified diet, without great hardships sledging, 7057-8; eggs not so antiscorbutic as milk, 7078, 7082; in future arctic expeditions would suggest increase of vegetables after six months, 7118.

Dr. Munro—

In the Crimea, herbs given by the Russian and French to make soup of, 8592-3.

Dr. Rae—

At Red River they got vegetables and flour, 8740; but not in more out-of-the-way parts, 8740-41; they got a few berries occasionally, 8741; the children's rations at the Great Bear Lake two pounds of meat a-day, 8710, 8784; ration of meat diminished when other food was given, 8794; the reindeer stomach with its contents eaten by the Esquimaux and hunters, 8786-9; what the contents and the taste are, 8863-5; thinks he did not himself eat eight pounds of meat a-day, 8790; has heard of sixteen pounds being eaten, 8791; on the Saskatchewan potatoes, if any, are given in addition to eight pounds of meat, 8792-3; the ration where he stayed, five or six pounds of goose and one pound flour, and with potatoes less flour, 8801; they lived for six or eight months without vegetables or farinaceous food, 8817; what is obtained travelling in the summer, 8818; fir-tops were not eaten, or spruce beer made in his journeys, 8823-6; diet of the Esquimaux, 8852-60; their preference for musk ox, 8853; and venison, 8853; method of obtaining fish, 8856; and spearing salmon, 8856; to what extent whale and seal is eaten, 8857-60; white whale kept in store at Fort Churchill for half-domesticated Esquimaux, 8860; they eat reindeer stomach, 8862; at York Factory chiefly salted meat, and, obtaining venison not being certain, preserved potatoes and cranberries issued in its absence, scurvy occurs under salt meat diet, 8794-8800, 8815-16.

DIET. 1. General, *continued*—

Of Sir J. Richardson's expedition, 1848-49—

During winter at Great Slave Lake, chiefly fish, 8709; rations allowed at the Fort, eight pounds fresh venison a day per man, or three large white fish, 8710, 8779, 8828; including bone, 8781; twenty-five pounds of flour for the winter, 8710-12, 8716; no tea, or very little, 8711-15; or biscuit, 8713; or spirits, 8714; the meat was boiled rather underdone, but never raw, 8782-3; Sir J. Richardson and the officers lived on the same diet, but a little more flour, 8832-3; the men had no longing for vegetables, 8835.

Sir A. Armstrong—

Animal food raw or partly cooked may keep off scurvy, 9002-3, 9167-8; there is a large amount of lactic and phosphoric acid in salt meat when raw, 9003; more food, especially fatty food, required in a cold climate, 9148-9.

Dr. Robertson's Letter at end of Evidence—

Oatmeal and potato good antiscorbutics.

2. On board Ship, Recent Expedition—

Sir G. Nares—

Recommendations of Medical Director-General as to issue of meat not acted on, 28; stock of meat not enough to give two pounds for three years, 29, 30; inability of men to eat more than one and a quarter pounds a day, 29; ration of preserved meat and salt pork increased by a quarter of a pound, 32; increase of ration of salt beef discontinued, 32; in no expedition have crew eaten one and a quarter pound of meat daily, 42; diet in recent expedition same as in last British expedition, 29; what extra food was given in "Alert" when men were exposed at night, 49, 106; coffee given as an extra meal for extra work, but there was little occasion for extra exposure, 106-7; no defect in food except that beef was hard and salt, 93; though pains had been taken to supply it, 93; collops being insufficient by themselves were issued with preserved meat, 9303; the men might have had all preserved meat, 9303; each mess had enough salt and other meat combined to use at meals, 9303; improvement in the salt meat when kept in snow houses, it was found good by the officers, 9303; the crew were prejudiced against it, 9303; the rations of bread too much and savings arise, 9303.

[Captain Stephenson—

The dietary of the "Discovery," what it was, 271, 301; adopted by order of Sir G. Nares, 272, 275-6; was frequently altered, independent of scurvy, 274; was modified to introduce fresh meat, 276-7; a slight increase of meat at times, 278-9; no change in vegetables or other antiscorbutics corresponding with increase of meat, 316-17; no change except increase in meat, 316-17; decrease of meat after departure of sledge parties, 318; reasons for alteration and increase of meat in May, 1876, 319-21; increased ration of flour, reasons for, 322; extra ration of bacon in August, 1876, 323; alterations on way home in meat, and increase of fruit, 330-31, 336; it was sufficient to maintain the health of crews, 280; the fruits were bottled, and pippins, 281; vinegar issued according to custom, 282; the supply most liberal, 289; extra issues at night for extra work, cocoa or coffee given, 366.

Captain Markham—

Could not be improved on, 538; allowance of meat not consumed, 539; they had compressed cabbage, 657; preserved meat very good, but fresh meat preferable, 658; preserved beef and mutton both supplied, no preference for either, 659; preserved soups given, ox-cheek preferred, 661; egg powder a medical comfort, 698; no preserved eggs taken, 699; greater amount of fresh meat in "Discovery," 769.

Lieutenant Rawson—

Men unable to eat the full allowance of meat, 1120.

Commander Beaumont—

Extra meal given when extra work took place, 1175.

Dr. Colan—

Victualling satisfactory, according to arctic scales, 1671; increase of meat in October, at his representation, 1673, 2123; amount given sufficient, 2124; the food satisfactory, except the beef, which was salt, 1674-7; not usual to consult medical officers as to service scales of diet, 1684; was not slighted in any way in this matter, 2170; what the preserved and compressed vegetables were, 1697-9; small amount of fresh meat given (fourteen dinners in ten months), 2075; more given to sick men, 2076; the amount given, 2185; there was sufficient fatty matter in the meat, 2097; no wish for more, 2098; pickles supplied, 2146; bread baked on board, 2164-5.

Dr. Moss—

Was satisfied with food on board, 2297; beef more salt than usual, though the quality was better, 2298; description of preserved vegetables and fruits, 2299, 2300; how far dry or moist, 2299-2301; what preservatives were added to water in which preserved, 2307-9; quality of vegetables very good indeed, 2312; preference for the moist, 2317; Edwards's preserved potatoes excellent, 2433-4; bread baked on board, enough for daily use, 2479.

DIET. 2. On board Ship, Recent Expedition, *continued*—

Dr. Ninnis—

How far vegetables and meat were served out together, 2523-4; scale of victualling perfectly satisfactory, 2555; a little mutton at Christmas, 2558.

Dr. Coppinger—

The salt beef hard and tough, 2982; inferior to ordinary beef, 2983; was satisfied with other food, 2984.

Admiral Richards—

Diet in recent expedition similar to his, 3123; was prepared by the Arctic Committee in order to complete the ships for three years, they considered it sufficient, 3193; the quantities intended to be the same, quality probably superior, 3131; no expense or trouble spared to procure everything of the best quality, 3131.

Sir L. M'Clintock—

More liberal than before, 3262; sufficient to preserve men in health, 3263; could not be materially improved, but should be frequently varied, 3397; the diet was framed independently of supply of game, 3398; the scale of diet for the recent expedition was considered by the Arctic Committee, 3371.

Captain Hobson—

The scale of victualling corresponds with that of the "Fox," 3497-9.

Dr. Lyall—

Scale of diet in late expedition sufficient to maintain health, 4289; his opinion as to dietary was asked, 4385; was in accordance with his views, 4386; was founded on experience of other expeditions, 4387-8; no reduction made of substances contained to their food elements, 4389; superintended coming of the beef supplied to the late expedition, 4405; was satisfied with it, 4406; the same meat used in former expeditions, of the best quality, and salted in the ordinary way, 4407; preserved meat rather insipid, 4411.

Dr. Piers—

Not much fault to find with it, the allowance of vegetables fair, 4677.

Dr. Macdonald—

The diet an excellent one, containing many antiscorbutics, 4861, 4902; sufficient for the maintenance of health, 4903.

Dr. De Chaumont—

Approximate estimation of the food principles, 4999; difficulty in ascertaining the amount of fat in corned beef and pork, 4999; the productive work of the diet if entirely assimilated equal 340 foot-tons, 4999; well calculated to keep off scurvy, containing many antiscorbutics, 4999; in every way liberal and adequate to support life, 5060; the fatty matters sufficient, if his estimates are correct, 5061; and if all the pork was eaten, 5062.

Dr. Pavy—

Advantage of the "Discovery" over the "Alert" in fresh meat, 5147; importance of considering the difference between the diet on board and sledging, 5148; the dietary on board good apart from lime juice, 5172, 5180.

Mr. Busk—

The ship diet of the late expedition was ample and judicious, 5249; but though excellent deficient in the vegetable element, 5249.

Dr. Guy—

Comparison of it with the diet of convicts at hard labour, 5323, 5330; contained 321 ounces per week, against 335 ounces for convicts at hard labour, 5323; and lime juice and vinegar and spirit against milk, 5323; its superiority in meat, but inferiority in potato, 5330; an adequate diet and equal to that of the convicts, assuming the work to be similar, 5324-5; does not consider the amount of water-free food of the diets important, 5328; real value of an article of food cannot be measured by its dry elements, 5329; thinks favourably of it, but would have increased the compressed and preserved vegetables, 5336-8; even sacrificing for that the meat, 5337.

Dr. Buzzard—

Vegetable diet insufficient with the lime juice given to ward off scurvy, 5454; dietary was fairly good, 5472.

Dr. Dickson—

The rate of victualling good, 5661; and quite sufficient, 5664; the quantity of pork might have been increased, 5662.

Vice-Admiral Ommanney—

Improved on Sir James Ross's, similar to Austin's, 5742; advantage of Edwards's potato; its antiscorbutic effect, 5797.

Captain Feilden—

There was ample food, 5930; perfectly satisfied, but heard salt meat was tough, 6024; ration was reduced, 6025, 6078; and stopped when scurvy existed to a large extent, 6078.

Dr. Barnes—

Admirable up to a certain point for a certain time, 7049; would require more vegetables after exposure to conditions likely to produce scurvy, 7051; preserved milk might be added as a general ration, 7053-4; without his proposed modifications, was becoming insufficient preventive, 7059, 7071.

DIET. 2. On board Ship, Recent Expedition, *continued*—

Alexander Gray—

Much better than in the whalers, 7202, 7253; the salt beef of "Discovery" considered rather salt, 7204-5; arrangements for meals and for issue of provisions, 7337-82; preserved meat used at breakfast, but not salt meat, 7338; what vegetables they had at breakfast, 7341-2; salt meat once a week; personally did not eat it, but some liked it, 7346-7, 7350, 7597; meat always at dinner, 7348-9; what food was given, 7344; saved meat, or ate the whole allowance, according to appetite, 7351-4; amount and descriptions of vegetables given, 7356-72; carrots three times a week, 7360; preserved potatoes four times, 7363-6; liked them, and had enough, 7367-72; pickles at every meal, 7377; what kinds they were, 7380; what food they had for supper, sometimes meat, 7376; no extra food given after the watch, 7382; liked the preserved meat, 7598-7600; plenty to eat, and everything necessary, 7602-3.

Thomas Rawlings—

The salt beef not so good as usual, 7628, 7669-71; the pork and other provisions very good, 7628-9, 7672-3, 7690-91; had as much food as he could eat, 7674; salt meat disliked from fear of scurvy, 7680; it was not taken up, being dry and hard, preserved meat of previous day made to last two days, 7683-9; vegetables given every day, 7693; they were liked, 7694-5; routine in which given, 7700; potato three times a week, 7697; as much as they could eat, 7701-3.

Color-Sergeant Wood—

The food was good, 7885-7; the salt beef too salt to eat, 7888, 7950; and was not taken up, 7929; could not make it suitable, 7950; did not like the minced collops and ox-cheek, 7891; they were good, but not popular, were called blood and sawdust, 7945; they were too rich to eat much of, 7949; the collops and beef were generally disliked, 7893, 7924; but no complaint was made to the captain, 7894; on the days they were issued part of the previous day's food was eaten, 7892; vegetables supplied once a-day, 7951-2; some were generally saved for supper, 7953; order and amount of issue of them, 7955; plenty of potato given, 7956.

Mr. Emmerson—

The salt beef and pork bad, 8100-8101; has never had such bad salt provisions, 8104, 8202-3; men used to make the preserved meat last two days rather than take up salt meat, 8104; which amounted to half-rations one day a week, 8210-11; could not eat it, 8104, 8329; the other provisions good, 8102, 8167-8; except the collops, 8225; the allowance was more than they could eat, 8103, 8222; the issue of salt meat stopped owing to objection to it, 8104, 8212; when this was done, 8204-5; a good deal of musk ox obtained, 8105, 8281-2; issued twice a-week, 8278-9; the old oxen tasted too strong and tough to be liked, 8106, 8287, 8345-6; the young nice 8287; preserved meat issued instead of salt meat, 8213; reasons for objecting to the collops, no substance in them, 8169-71; many puddings cooked, 8172; what issues for them were made, 8175; plenty of flour issued, it was liked, 8173-6; compressed vegetables not cared about, 8184; preserved vegetables liked in soup, 8185; chocolate drunk but tea preferred, 8186; preserved milk distributed from ward-room during return, 8187-8; the objection to the salt beef was on account of hardness and saltiness, 8189-90; why not complained of before "Valorous" left, 8191-2; it was not taken up or eaten, and therefore could do no harm, 8194-8, 8207; the pork was nice but fishy, 8190, 8203, 8217, 8330; it was issued once a-week throughout the winter, 8214-15; only about half the men took it up, the rest left most of it behind, 8214, 8217-24, 8331; objecting to it as fishy, 8332-3; the meat taken up and cooked was divided among all the messes and sometimes eaten cold, 8224; no savings were paid, 8223; the ox-cheek was good, 8226-28; the minced collops were not liked, 8168, 8225; the half-rations issued with other preserved meat were not eaten, 8229-34; the captain altered the diet in consequence, 8233-35; the alteration being made directly matters were represented, 8334-35; the want of food not felt in spite of not eating all the food, 8236-38; preserved potatoes issued thrice a-week, and were popular, 8267-8; he had them by saving every day, 8265.

William Jenkins—

The provisions were more than sufficient, 8502; the provisions good, but continual preserved meat monotonous, 8380, 8497; did not eat the salt meat, 8381, 8461; it was beautiful meat, but too salt, 8382, 8424, 8463, 8501; salt meat considered bad for scurvy, 8382, 8461; objected to on that account, 8462; used spare preserved meat in lieu, 8382; the pork good, better than any he had had before, 8383-5, 8425; was not fishy, though some thought it so, 8503; vegetables issued every day, 8452-3; carrots and cabbage good, but not the onions, 8453-5; quite sufficient potato issued, 8456-7.

Mr. Thomas Mitchell, R.N.—

In "Discovery," vegetables served every day, 8890; the kinds and the order of rotation, 8891-5; quarter of a

DIET. 2. On board Ship, Recent Expedition, *continued*—

pound of Edwards's preserved potatoes seven days out of fourteen, 8892-5, 8917-19; diet very good, 8905-6; and liked, 8906.

Sir A. Armstrong—

Diet not sufficient for lengthened arctic service, 8956; recommended two pounds a-day (but not two pounds without bone), so as to give meat three times a-day; men should have been made to eat it, 8956; his recommendations not carried out, meat not given for breakfast or supper, 9061; objections he made to the scale proposed as not good enough to keep off scurvy, 9243; quantity of food sent out increased, 9244; but the ration not up to what he had advised, 9245; the deviation from his views as to diet had not affected the men's health in spring, 9121; average increase of weight of men considerable, 9139; greater increase in "Discovery" points to more nutritious diet, 9140; Captain Naré's at liberty to use what diet he pleased, 9266; not as varied as, or equal in amount to, what he had recommended, 9269.

3. On board Ship in Former Expeditions.

Captain Hamilton, "Assistance" and "Resolute"—

Advantage over recent expedition in beef not being so salt and daily ration of bacon, 3028; how the bacon was carried and stowed, 3029-31; "Resolute" well supplied with vegetables, 3069; of what kinds, 3070; preserved meat more freely used in recent expeditions than formerly, disadvantage of this, 3041.

Admiral Richards—

The allowance of food in "Assistance" sufficient, there were savings, 3125; rations never reduced, the dietary the ordinary one, 3198.

Sir L. McClintock—

What vegetables they had in the "Enterprise," 3363; they were short of weight, 3364; extra food with special night work, 3285-6.

Captain Hobson—

Vegetable diet when in "Rattlesnake" similar to that given now, 3453; could buy from the Esquimaux or shoot any amount wanted, 3522-3; seals obtained in the spring and autumn in the "Fox," 3430; game should not be counted on, 3496.

Dr. Toms—

Extra issues to prevent illness when "North Star" was on her beam ends, 3554; fresh meat given instead of salt, 3591, 3662; extra meal (rum and lime juice) given for night work, 3581; brewed beer, 3608; some taken from England, 3609; use of tobacco, 3610; account of the diet of "North Star," sauer kraut given, 3662; the sauer kraut was a present, 3673; and was regarded as a medicine, 3675; no fish or blubber obtained, 3690-92; no fresh meat or fish in "Pioneer," 3712-13; craving personally and of men of "Pioneer" for fat bacon, 3739-40; preserved meats liked, 3741.

Captain A. Young—

Provisions of the "Fox" similar to those of Government expeditions, 3802; visited provisions left by "Fury" in 1825, sugar, carrots, soups and flour, 3874-5; they were in good order, 3876.

Dr. Seott—

The ration on board "Intrepid" sufficient, 3911; their provisions were first-rate, 3921; there were pickles, bacon instead of pork, and superior corned beef, 3958-9; comparison of scales of diet with "Alert's" in favour of "Alert," 3960; but "Intrepid" had fresh meat, and a good deal of beer, 3960.

Mr. C. Ede—

Diet of "Assistance" sufficient to maintain health, 4043; difference between it and "Alert's," "Assistance" had chocolate with milk and sugar beer, 4045-6.

Dr. Lyall—

"Assistance" scale of victualling varied from time to time, 4288; much the same as that of the late expedition, 4345; list of vegetables supplied to "Assistance," 4346; two kinds of potato, 4347; Edwards's preferred, 4348.

Dr. Piers—

Scale on board the "Investigator" during first winter, 4447; three-quarters of a pound of meat, 4447-8; the crew in a good condition after the winter, though they would have liked more, 4449-50; it was not sufficient, 4451-2; reduction of allowance the second year at Mercy Bay to half-a-pound of meat and two-thirds of a pound of flour, 4456; crew suffered from want of food, 4458, 4462; fresh meat got, 4459, 4460, 4607-8; in 1851-2, fresh meat once in ten days, 4609; reduction the second winter in Mercy Bay in vegetables, 4482; injurious effect on health of crew, 4508-10; this dietary remained in force till they left, 4652; placed on full rations on arriving at "Resolute," 4483, 4653-4; the supply of vegetables in 1851 not liberal, 4592-7, 4601; the actual quantity short of the nominal, 4593; four ounces not equal to more than one and a half really, 4595; vegetables preserved in fluid preponderated, 4596.

DIET. 3. On board Ship in Former Expeditions, *continued*—

Dr. Dickson—

In his voyage to the antarctics preserved vegetables and meats, and dried fruits, 5676, 5720.

Vice-Admiral Ommanney—

The allowance of preserved meat in "Assistance," three-quarters of a pound, 5743; salt meat, do., 5746; statement of dietary, 5745-8; issues in March, 1851, 5747; biscuit, flour, or rice, one pound daily; rice not liked, 5747; his dietary excellent, 5751; would recommend more green peas, 5751; preparation for sledging; extra issue of potatoes and beer, 5753; extra meal when in White Sea in first and middle watches, 5899.

Rear-Admiral Pullen—

In "North Star," diet much the same as in recent expedition, 6207.

Mr. Bayley—

"North Star"—

Provisions ran short, 6260-63; used to pipe hands to grass, 6299; had Edwards's potatoes, 6302; preserved meats bad, 6314-18, 6329; what other meat there was, 6330; and vegetables, 6331-3; little game, 6363-5, 6439.

"Assistance"—

Allowance full and sufficient, 6264-5; biscuit saved, not meat, 6266-7; what the meat and potatoes were, 6269-70, 6349-53; potatoes twice a-week, 6270-71; not every day, 6353; vegetables every day, 6352; what their breakfast was, 6478; no general complaint of the diet, 6481; the salt meat expressly provided, 6482; it was liked as much as preserved meat, 6483.

J. Organ, "Resolute" and "Assistance"—

Sufficient provisions, 6560, 6659; all very good, 6657, 6682; and plenty of everything, 6659; three sorts of potatoes, 6598-9.

"Enterprise"—

What the diet was, 6537; not enough to eat, 6538; provisions bad, 6604; preserved meat very bad, 6539; also the salt meat, 6594; got a good deal of fowl, no muck ox, 6590-91, 6790; preserved vegetables good, 6595-6; what they were, 6597-8; plenty of them, 6603; about half-a-pound a-day, 6605-6; potatoes three times a-week, 6608.

Mr. Murray, "Enterprise," 1850-55—

Provisions very good, except some of the preserved meat, 6868; had sufficient food, but could have liked more, 6869; very little game after the first winter, 6872; it all went to the sick, 6870; more the second winter, but on short allowance of tea and cocoa, 6881; what game and fish they got the second year; caught salmon with a seine in the lakes, little game in the winter, 6980, 6996; had plenty of vegetables in "Investigator" and "Enterprise," 6957; what they were, 6958; some issued every day, 6959; in what amount and rotation, 6960-61; the only time short of provisions was when travelling, 6917.

"Investigator," 1848—

Provisions were inferior, 6837; preserved meat bad, the contractor subsequently was fined, 6838; other food good, 6839-42; a good allowance of preserved potatoes, 6843; had enough to eat during the winter, 6844.

Alexander Gray—

Diet in Merchant Service—

Provisions in whalers, 7200; seal meat obtained from Esquimaux, and was popular with some men, 7200-1, 7268; no other fresh meat, 7268; food in the late expedition much better than in the whalers, 7202, 7253; account of diet on board the whalers, 7255; a liberal allowance of whole or preserved potatoes given twice a week, 7255-65; but not so much as in a Queen's ship, 7266-7; whale was eaten and was found good, tasting like periwinkles, 7269-72; what whale they ate, 7569-72; black whales eaten by Americans, not by English, 7562-64; how whale and seal were cooked, 7273-76; objections to blubber, 7277-8; lived upon whale on the pack, for fifteen days on nothing but whale, 7279-83; doubt whether the whalers which had scurvy had vegetables or fresh meat, 7299-7302; molasses used, but not much, 7586-88; Americans use them much, 7589-90; Americans take raw potatoes as pickles, 7591-2; the salt meat not so salt as that of the "Discovery," 7601.

Sir A. Armstrong—

"Investigator" in 1850-54—

In Mercy Bay provisions limited, 8939; diet very inferior to recent expedition, less meat and vegetables, 8954; occasionally got fresh meat, 8976; to what extent, 8977; much sorrel obtained in 1852, used as salad, 9034-5; very little fresh food obtained at the Sandwich Islands, and no vegetables, 8935, 9191; no fresh food before except some beef, 9187; reasons for scarcity of vegetables, 9191; reduction in amount of meat and other food, not vegetables, 9212; fresh meat a substitute for, not a supplement to, other food, 9214; no change in diet till abandonment of ship was decided on, 9223; liberal allowance on board "Resolute," 9229; more fresh meat than before, 9240; and the dietary better, 9241; opinions of men as to sufficiency of diet not asked in "Investigator," 9272.

DIET. 3. On board Ship in Former Expeditions, *continued*—

A few fish and birds obtained along the coast of America, 9192; considerable amount of fresh food obtained at Mercy Bay, 9209, 9210.

Dr. Robertson's Letter at end of Evidence, p. 316—

"Enterprise," 1848-49—

Recovery from scurvy chiefly due to supply of sea-birds, mode of preserving them, and their use as soup with potato and oatmeal, the ship had plenty of fruits and vegetables.

4. Of Officers—

Sir G. Nares—

Felt want of change less owing to supply of sauces, 35; had very little live stock or fresh meat, 37; had no private stock of beer, 50, 51; what private stock they had, but little of fruit, the ship supply large, 52, 53; no private storeroom, except that wine was carried in the spirit-room, 53, 54.

Captain Stephenson—

In what respects they had better diet, 283-4; what wine, 285.

Commander Beaumont—

Diet on board ship, additions to ordinary rations, 985.

Lieutenant Rawson—

What private stores they had, 1122.

Dr. Pavy—

The more varied diet of the officers protected them from scurvy, 5164-6; the jams may have been antiscorbutic, 5168-9.

Dr. Buzzard—

Immunity of officers due to their extra fruits and vegetables, milk, and butter, 5455.

Captain Feilden—

Difference between diet of officers and men; wine, sardines, jams, and potted meat, 5928, 6032; cheese and butter, 6032; one officer had some cranberries, 6034; port and sherry, with a little champagne, the wines, 6035-6.

5. Sledging or Travelling Diet.

Sir G. Nares—

Tea given for lunch in lieu of spirits, 107 8; advantage of this, but objection to the halt, 192, 197-8; absence of fresh meat, comparison with Admiral Ommanney's sledging, 155; dietary for sledging more than sufficient at starting, 161, 163; dietary should be sufficient to keep men in health, 163; comparison of diet with that on board ship, 164; diet drawn up after great experience, and had been previously successful, 166; Sir James Ross had another dietary, 166, 168; tea greatly appreciated, 181; allowance of tea increased, of rum decreased, 192; comparison of diet with other expeditions, 203; recent one similar to that of "Resolute" (1852 to 1854), 203-4; sledge crew of Lieutenant Osborn supplied with pickles, but had a case of scurvy, 9303; the ration of two ounces of potatoes was the same amount the men would have received in the week on board, 9303; necessity for the officer and the captain of the sledge to weigh out the provisions, 9311; the sledge diet was practically sufficient, 9376.

Captain Stephenson—

What the sledging rations were, they were sufficient, 337-42; men did not eat all their pemmican at first, 338; allowance of pemmican and bacon ample, 340-41; would not increase bacon, 341; all the rum consumed, but some as fuel, 360-66; sledging dietary was designed to support strength, 422; solid food was in sufficient quantity, 424; believes dietary was fixed by Arctic Committee, 443, 460-63; how far medical officers were consulted about it, 444-5, 464; how first brought under his notice, 462; a smaller quantity of sugar might be sent, 495.

Captain Markham—

Dietary sufficient, 540; sufficient bulk of food and not always consumed, 540-41; could not be improved on, 543; vegetables an improvement, if they could be carried and cooked, 545; preserved potatoes taken, 545; bacon contained a great deal of fat, 547; difference between the autumn and sledge dietaries, 548-9, 553; preserved meat and more bacon in autumn, 553; potato, onion, and curry powder eaten, mixed with pemmican, 550-52; what provisions were placed in depot in the autumn, 556-8; in the spring, 564; no medical stores or comforts, 559; men not at first on full allowance of pemmican, 591; being unable to eat it, 592; would not recommend additional tea, 663; butter might be advantageous when sledging, 688; men took to food kindly, with few exceptions, 728-9; whole allowance of pemmican not eaten, being unable to cook it, 730-31.

Lieutenant May—

Sledge dietary, difference between spring and autumn, 792; extra half ration of potatoes taken the last journey, 793.

Commander Beaumont—

Had only obtained one ptarmigan sledging, 888; diet changed at Thank-God Harbour, 890; what it was afterwards, 891; preference for preserved meat over pemmican, 902; but a larger quantity required, 903, 1199; the preserved meat was very good, 1199; diet when

DIET. 5. Sledging or Travelling, *continued*—

crossing from Thank-God Harbour to Cape Baird, 922; men would have held out longer had game been procurable, 936; diet not sufficiently varied, 956; more succulent vegetables should be carried, 957; want of appetite when first sledging from dislike of pemmican and fatigue, 961; how far this was due to extreme cold, 965.

Lieutenant Rawson—

Rum was taken in tea, 1166; makes the men sleep better, and cheers them, 1159; tea cannot be too highly spoken of, 1160.

Lieutenant Giffard—

Advantage of tea, the men looked forward to it, 1232; the tea and spirits given separately, 1247.

Commander Aldrich—

To what extent he used tea, 1295; preference for tea at luncheon, but disadvantage of delay in making it, except when working half loads, 1296; suggestion to take a small amount of preserved meat when sledging, as a change of pemmican; pemmican excellent, but not suited to all; whole allowance of preserved meat (found in depôt) eaten even by sick men, 1303; facilities for measuring off daily rations very advantageous, 1303; 1 lb. preserved meat used instead of pemmican and bacon in autumn, 1316; none in spring, except that sent to depôt, 1331; water in autumn chiefly from melted snow, 1320; it was good, 1321; also in spring, 1370; found nothing but moss and a poppy, 1393; advantage of rum and tobacco at night, 1401; how the rum, pemmican, and tea was taken at night, 1401; advocates tea in the middle of the day, 1405.

Commander Parr—

Preference for tea over rum for lunch, 1464, 1516; more fit for work after tea, without the unpleasant reaction produced by rum, 1516; and which produced weakness, 1517-18; men did not smoke much, but smoked himself, 1466-7; difficulty about it in cold weather, 1468; potato carried in bags, 1488; remained perfectly good, 1489; it was cooked and eaten with the pemmican, 1490; the full allowance eaten at first, not after by sick, 1491; both plain and sweet carried, 1492; it had to be eaten with salt, 1493-5; sick men preferred bacon, 1497; his appetite remained good longer than that of any one else; was always able to eat his allowance, 1504-7; the food ample in quantity, 1476; and of good quality, 1477; but other articles should be tried, 1477.

Dr. Colan—

Not consulted about sledge dietary, 1746-8-9; was not slighted, 2170; was aware of its nature, 1745-7; and could have expressed his opinion, 1750; it was totally different from ship diet, 1778; was very good, 1779; and if consumed, good for hard working men, 1780; Edwards's preserved potato supplied, 1787; slightly boiled before eating, 1790; was liked by the men, 1791; preference for tea over rum for luncheon, 2022; men more vigorous and able to endure fatigue, 2023-4; advantage of compressed tea, 2127; chewing tea leaves not antiscorbutic, 2141-2.

Dr. Moss—

Diet in autumn; rum for lunch; preserved meat instead of pemmican, 2193; preserved potato and biscuit taken, 2194-8; what dietary of sledge parties was, how far vegetables were represented, 2314; curry paste only a condiment, 2316; succulent vegetables could not be carried, 2319.

Dr. Ninnis—

Difference between it and diet on board, 2593-4; substitution of pemmican for preserved meat, 2593; omission of lime juice and beer, 2593; 2 oz. of Edwards's preserved potato supplied, 2612-3; no succulent vegetable, 2644.

Dr. Coppinger—

Recommends doubling allowance of potatoes; omission of spirits; taking dried fruit and essence of beef, preserved milk and spirits, as medical comforts, 2933; bacon not substituted for pemmican, 2989, 2991; though an increase of it was sometimes made, 2989; pemmican taken in exactly the same way, independent of bacon, 2990.

Former Expeditions—

Captain Hamilton—

Antiscorbutics carried besides lime juice, 3004; description of diet, 3051; biscuit dust changed to Edwards's potatoes, 3052-3; preserved meat not so good for travelling on as pemmican (case of Lieutenant Meeham's crew), 3057.

Admiral Richards, "Assistance"—

Diet slightly less liberal than in recent expedition, 3118; but they had half-gill more rum, 3119; tea not given at luncheon from want of time and fuel, 3122, 3175; smoking difficult, except at night in bags, 3138; tea very much prized, but it could only be taken once a day, 3176; in early sledge travelling, some days elapse before men can eat pemmican, 3187, 3223; Captain Nares' sledge dietary taken from those of former expeditions, 3192-3; it was not proposed by the Arctic Committee, 3194.

Sir L. M'Clintock—

With Sir J. Ross meat half salt and half preserved, no pemmican, 3250; the diet of recent expedition much the

DIET. 5. Sledging or Travelling, *continued*—

same as formerly, but more biscuit and tea, 3267-8; could not be changed for the better, 3269; got a good deal of game, 3306; diet of Sir J. Richardson, 3387-90; advantage of fresh meat in journey to Melville Island, 3392; the amount got, 3393; it was eaten cooked, 3394.

Captain Hobson—

What fresh meat he got in spring journey from "Fox," 3430; sledging from "Rattlesnake," pemmican and preserved potato taken, 3458-9; but it should not be considered, game being plentiful, 3481; pemmican taken from the "Fox," and preserved potato and onion powder, 3485; the dietary of recent expedition the same as that of "Fox," 3487; and as good as could be, 3540; different from Behring's Strait sledge diet, 3503-4; great value of tea, 3547; rum should be taken, one gill a-day enough, 3548; men worked better after luncheon on it, 3549; what their luncheon used to be, 3549; men have expressed themselves ready to give up rum rather than tea, 3550.

Dr. Toms, "North Star"—

What the dietary was, 3693; lime juice and milk omitted in recent expedition, 3694; otherwise similar to his, 3695; tea is most refreshing, 3749; time tea takes to make, 3757; the halt would not be injurious in checking perspiration, 3758.

Captain A. Young—

Sledging from "Fox"—

Destruction of depot fuel by a bear on third journey, and consequent scarcity of it, 3787; diet consisted of pemmican, biscuit, tea and tobacco, 3791; for forty-one days, 3792; would take both tea and rum, 3804-5; excluding rum, if one must be excluded, 3806; want of fuel would have prevented them having mid-day tea, 3806; what fuel they carried, 3807; it would not do to stop rum when sledging, 3880.

Mr. Ede, "Assistance"—

In sledge journeys in autumn, pemmican, pork, and chocolate and milk, 4066; the diet in spring (similar, with biscuit and tea), 4069; preference for tea over rum, 4099, 4100; the reaction from excitement of the rum produces too much depression, 4101; tea should be given at mid-day when undergoing exertion, 4104; what game they found on their journeys, 4108; his dietary similar to that of "Alert," but had no stearine or onion and curry powder, and less potato, 4144-6; arrangements for cooking, 4180; potato the only vegetable, 4181-4; it or biscuit crumbs mixed with the pemmican, 4183; did not obtain Greenland cress, 4185; used saxifrage with pemmican on a seven days' shooting expedition, 4186-8; difficulty in thawing water and making tea, 4216; would add lime juice and preserved milk to dietary of recent expedition, 4251.

Dr. Lyall—

Dietary of recent expedition similar to that of "Assistance," except lime juice, 4295; he did not give any advice about it, 4399; the sledge diet should be more varied, and have more vegetables, 4409; preserved meat as a change on pemmican advantageous, 4410; what vegetables "Assistance" had, 4349-51.

Dr. Piers—

The "Investigator's" diet, biscuit and oatmeal, 4575; no potato, 4575-6; not sufficient fuel for cooking, 4576; small amount consumed on one expedition, 4576, 4584; owing to want of fuel to cook, 4584; no fresh vegetables obtained, 4587; no bacon, onion powder, or curry paste taken, 4674; the sledging ration in recent expedition not liberal, 4673; the allowance of vegetables small, 4674.

Commander Cameron—

In his journey across Africa his men bought their own food, receiving money for the purpose, 4787; diet varied, and was fowl, goats, cassava or cooked ferns, and other vegetables, 4701, 4706; at Bihé they lived well, and had oranges and onions, 4701; just before scurvy broke out they had been going through a country with much wild fruit, 4701, 4749; most pressed for food during the last part of the journey, 4705; except at Bihé had little meat since June, 4790; they had flour made into dampers, and but little animal food, 4708; had had plenty of fruit and sweet potatoes at, or just before, the occurrence of scurvy, 4709; but had not always had it, 4791; had no milk when scurvy broke out, got some near the coast, 4716; the natural food of the men flour made into porridge, with occasional meat and vegetables, &c., 4746; meat once or twice a month, 4788; they had more meat with him than customary to them, 4748; sometimes two or three times a week, 4789; but vegetable food their main subsistence, mushrooms, beans, bananas, cassava leaves, and ferns, 4750-52, 4780; two kinds of plum and plantain, and guava, 4478-80; he himself fed on these, dampers made of flour, and what meat he could find, 4781; and drank water or Indian corn coffee, 4781-2; a stock of food laid in where plentiful, 4763; good diet of rice and milk during detention at Kilemba, 4768; his men used beer made out of honey or fermented palm wine, 4777; he did not like it, but drank palm wine, 4783; no salt meat, 4809-10; had

DIET. 5. Sledging or Travelling, *continued*—
occasionally abundance of vegetables, never long without,
4812-13; amount of fruit varied, 4813.

Dr. Macdonald—

Two ounces of potato in recent expedition not enough,
4907; diminution of antiscorbutics, except potatoes,
4861, 4905.

Dr. De Chaumont—

Good as regards actual quantity of food, 5000; estimation
of its food principles, if assimilated to the best advantage,
5000; the nitrogen in excess, and probably wasted, 5000;
thus occasioning a loss of productive work, 5001; elimi-
nation of antiscorbutics, except potatoes, 5001-3; advan-
tage of sugar instead of some nitrogen in the pemmican,
5002; disadvantage in want of the soft bread, 5003; not
surprising that scurvy occurred with it, 5005; the men
were worked up to the total productive power of their
food, 5008, 5015; if the food was not all eaten the
nourishment was insufficient, 5016; consequent necessity
of having more antiscorbutic food in it, 5017; tea prefer-
able to rum, 5101.

Dr. Pavy—

Omission of antiscorbutic food except potato, 5148, 5188,
5232; *i.e.*, of vegetables or their substitute, lime juice,
5233; it was good for producing work, not for maintain-
ing health, 5183-7, 5232; the albuminates, and fat, in
excess of average dietaries, pemmican being rich in them,
5186; scurvy to be anticipated on it, even if starting in
a healthy condition, the potatoes being too small in
amount, 5189-90.

Mr. Busk—

Deprived of all vegetable except potatoes, and part uncon-
sumed, being disliked, 5249; the men were unable to eat
the biscuit after the gums were affected, 5249; insuffi-
cient to support health under the circumstances even had
it all been eaten, 5249; contrast with the large quanti-
ties of meat eaten by Sir J. Richardson's men and the
Esquimaux, 5249; reduction in the solid food from
forty-seven ounces a-day to thirty-nine, when more was
requisite, 5249; allowance must be made for the larger
proportion of water-free solids, 5250-52; the deficiency
not in the allowance but in the men not eating it,
5253 they might be induced to take more by giving
more palatable food, 5254; but there would be a diffi-
culty in carrying meat with juices in it, 5255.

Dr. Guy—

Comparison between sledge and convict diet, 275 ounces of
solid food in sledges, against 335 ounces, 5323; superi-
ority in meat, inferiority in bread and potato, 5331;
only fourteen ounces of preserved potato in it, 5330-31;
the potato element very small, 5331; decidedly defecti-
ve, 5331, 5339, 5344, 5384; onion and curry powder do
not go very far to make up for absence of other vege-
tables, 5331; the vegetable diet defective, 5340-43;
especially considering the omission of lime juice, 5341-2;
the total quantity of food low compared with the convict
diet, 5344; scurvy to be expected under it, sooner or
later, 5345; would have increased the potatoes to a half
pound, 5385; the sledge parties should have been dieted
before starting on the sledge diet, 5414.

Dr. Buzzard—

Deficiency of starchy element of food, 5481; importance of,
on account of cold, 5483; two ounces of potatoes, and
the onion and curry powder inadequate, 5484-7; impos-
sibility of long exemption from scurvy on it, 5503.

Dr. Dickson—

The rations mostly sufficient and well selected, but the
antiscorbutics insufficient, 5622; men living on it would
be subject to scurvy, 5623.

Vice-Admiral Ommanney, "Assistance"—

Statement of his sledge dietary, 5753; did not take potato,
but other sledges did, 5754, 5816; tea sometimes prefer-
red, not given for luncheon, but after tenting, 5771-3,
5914; only two birds obtained, 5825; one or two cases
of Moore's milk taken, 5835-6; it was an excellent thing,
5835; no difficulty in using it, 5838; description of it,
5853.

Captain Feilden—

Used pemmican, 6039; ate his own allowance, and some-
times more, 6040; the potatoes were cooked mixed with
it, 6041-4; the allowance of potatoes was very good,
6043; good drinking water obtained, 6046; advantage of
plan of Esquimaux in eating snow, 6065-7.

Rear-Admiral Pullen, "North Star"—

Same as on board ship, but more preserved meat and pem-
mican, and Moore's chocolate, 6221-2; list of sledge pro-
visions, 6230-35; seldom took spirits, but made tea,
6242; smoked at night in their bags; did not want
spirits, 6243.

Mr. Bayley, "Assistance"—

Pemmican and potatoes, 6286-91, 6377-82; had enough
and ate all, 6289-90; no preserved vegetables, 6376; one
deer shot, 6378; rum was popular at night, 6500-1.

J. Organ, "Assistance"—

Three kinds of pemmican carried, 6666, 6692-3; and issued
in turn, 6667; one pound of biscuit a day given, 6669;
and a small daily ration of Edwards's potato cooked

DIET. 5. Sledging or Travelling, *continued*—

with pemmican, 6671-3, 6694; pickled onions taken by
Admiral Osborn, 6694-6706; how made and eaten,
6703-8; chocolate given for breakfast, 6771.

J. Organ, "Enterprise," 1848-49—

Took concentrated peaspoup, salt pork, and bad preserved
meat, 6628-30; no potatoes or vegetables, 6629.

Mr. Murray, "Investigator," 1850, "Enterprise," 1850-55—

Cocoa, biscuit, pork, pemmican, potatoes and rum, 6873;
what the meals consisted of, 6873, 7016; got a little
game, 6874; preference for rum at luncheon, 6922;
making tea wastes time, 6922; rum and pork for lunch,
7016; what amount of preserved potatoes they had
travelling, 6970-77.

Mr. Murray, in late Expedition—

More vegetables sledging would have been better than lime
juice, 7014; the quantity taken not enough, 7015;
objection to tea for luncheon, and thawing bacon in it,
7015.

Dr. Barnes—

The potatoes in recent expedition insufficient in amount,
7045; very defective in vegetable diet, 7061-2.

Alexander Gray—

Diet sledging from whalers less monotonous, being handy
to the ship, 7252; pork, not pemmican, taken from whalers,
7594-6; in recent expedition, all the potatoes eaten, 7460;
some would have liked more, 7464; less than on board
the "Discovery," 7463; arrangements for meals and for
food given at times, 7467-73; bacon was not eaten
towards the end of the journey, 7474.

Thomas Rawlings—

Men worked better after lunch of tea and bacon than in
the morning, 7662-3; preference for tea at luncheon,
7665; appetites good and full allowance eaten, 7734-5;
it was sufficient, 7737; and enough potato, 7738-41;
tea liked, 7851; and was hot when drunk, 7852; in
autumn sledging the only difference was taking pre-
served meat instead of pemmican on a short journey,
7704-8; and six ounces of bacon instead of four in
spring, 7751-56.

Color-Sergeant Wood—

Liked the diet whilst he was well enough to eat it, 7900,
7972-3; would have liked more potato and bread, and less
pemmican, 7901-2; to what extent, 7980-81; preference
for tea over rum, 7914-15, 7918; the potato might
be a trifle less than on board, 7975.

Mr. Emmersou—

Objects to rum whilst travelling, and prefers tea, 8177;
rum is useful when in the sleeping bag by giving a glow
and inducing sleep, 8177-9; especially if taken in tea,
8179; tea twice a-day, 8180; diet sledging in the
autumn, 8289-90; the same rations taken as in
spring, 8291-3; the spring ration more than they could
eat, 8296; but could have eaten more biscuit, 8297-8,
8301; had as much potato as they could eat, but less
than on board, 8302-5.

Wm. Jenkins—

Tea best for travelling on, 8420; potato issued daily,
perhaps as much in the aggregate as on board, 8458-9;
suffered from thirst, ate ice, 8466-7; could not suggest
any improvement, 8498, 8500; plenty in quantity of
provisions, 8508; but limited in kind, 8507.

Dr. Munro—

Two ounces of preserved potato not sufficient in a dietary,
8693-5.

Dr. Rae—

His men could always eat more than their allowance of pem-
mican, 8778; when sledging, diet in detail, tea for
breakfast and supper if possible, 8806.

In Journey, 1845-46—

Diet when sledging, one and a-third to one and a-half
pounds pemmican, one-third pound flour a-day, in
second sledge expedition, tea, chocolate and sugar, and
some game got, no spirits given, 8722; the ration
not enough, 8723; no vegetables for fifteen months,
8819-21; drank tea, chocolate, and water, 8822.

In 1850—

Lived chiefly on deer and half-a-pound flour a-day, and a
little pemmican, 8744; little spirits or tea, 8746.

In 1853-54—

Winter diet at Repulse Bay, 8747; venison *ad libitum*, no
spirits, cooked only once a-day, 8747; list of diet in
spring sledging, took pemmican, flour, preserved potato,
and condensed milk, 8747; extract of tea prepared
by Dr. Bence Jones useful, 8747; but little game
obtained, 8747.

Mr. Mitchell—

Soluble chocolate, not that mixed with milk, was taken
sledging, 8920-21.

Sir A. Armstrong—

Objection to long halts for luncheon, 9013; the vegetable
element in the recent sledge diet too small, 9113-14;
the effect of the potato and other antiscorbutics taken
in the recent expedition very feeble, 9274; would omit
some pemmican and sugar so as to take lime juice,
9281; advantage of taking rather fewer days provisions,
9282.

DISEASE. [*See Scurvy, Health.*]
DISCIPLINE—

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Winter routine of "Alert"	4
Daily routine of "Discovery"	11

Evidence.

Sir G. Nares—

Carrying lime juice recommended by the medical officer of "Alert," 214; but not sent, 164-179; there is no foundation for the insinuation of want of free communication with the medical officer, no difference of opinion except as to carriage of lime juice existing, 9303; recommendations of Sir Alexander Armstrong as to taking lime juice sledging could be only suggestions of an arctic officer, unless he gave reasons, 9324; a good reason should be given for the change of system, 9328.

Captain Stephenson—

Recommendations of Medical Director-General as to issue of lime juice carried out on board, 362; and as far as practicable, 458-9.

Dr. Colan—

Always felt free to make any representations he felt proper, 2171; not usual to consult medical officers as to service scales of diet, 1684; was not slighted in any way in this matter, 2170; was aware of exclusion of lime juice from the sledge dietary, 1751; was not consulted about sending it, 1753; suggested it being sent, 1756, 2175-6; but he gave no reason for doing so, 1759; understood it could not be sent unless other essential things were left out, 1756-60, 2055; did not see any means of remedying objections to its weight, and that of fuel for melting it, without reducing extent of travelling, 1762.

Dr. Ninnis—

He advised lime juice should be taken sledging, 2646-7; discussed the question with the captain, but did not urge it as of vital importance, 2722.

Color-Sergeant Wood—

No sentry-go on board, 7919-21; spirit-room kept locked, 7921; the marines did duty as blue-jackets and ward-room servants, 7922.

Sir A. Armstrong—

Absence of free communication between Captain Nares and the medical officer as to what was most suitable for sledge travelling, 9055, 9287; the captain should have originated the consultation, 9287; the medical officer had concluded his duty when he represented lime juice should be taken, 9288; but might have made a written remonstrance, 9288, 9289; this not absolutely necessary, 9289; remonstrance by medical officer of "Discovery" not fully enough done, but the adoption of the same dietary as the "Alert" compulsory, 9290; how far Dr. Colan was justified in not writing a remonstrance, 9291; no remonstrance shown by the doctor's evidence, but Sir G. Nares has accepted the responsibility of the omission of lime juice from the sledge diet, 9295-7; it is not incumbent on an officer to express his remonstrances in writing, 9302; drew up a paper of recommendations and suggestions for the recent expedition which was referred to in the sailing orders, consequently considers they should have been regarded as orders, 9041, 9285-6; did not refer to any great extent to scurvy, because he anticipated his anticipations as to lime juice would be carried out, 9089; adheres to what he drew up, 9268; aware that the recommendations were sent to the ships for information, not for guidance, 9285-6.

DISCOVERY," H.M.S. [*For Equipment, see under that head.*]

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Number of men wintering in her reduced on account of smaller lower deck, 216.

Captain Stephenson—

What the routine of the ship was, 367; was commissioned 15th April, 1875, 254.

Dr. Ninnis—

Crew originally fifty-eight, 2507; increased to sixty, one man and an Esquimaux added, 2509; seven men and an officer wintered in "Alert," 2510.

DOBING, WILSON, Gunner, R.M.A., of "Discovery—

Dr. Ninnis—

Scurvy (after sledging in North Greenland), 2580.

Dr. Coppinger—

His case, 2748-9.

DOBING, WILSON, *continued*—

Commander Beaumont—

Recurrence of disease with the work crossing from Polaris Bay, 921.

DOGS AND DOG SLEDGES. [*See Sledging.*]

DOIDGE, JAMES, Petty Officer of "Alert"—

Commander Aldrich—

Date of attack of scurvy, 1268, 1346; when and why he detected illness to be scurvy, 1269, 1358.

DOMINIQUE, V., or DOMINIC, Ship's Cook of "Alert"—

Sir G. Nares—

Attack immediately on return, only away three or four days, 148.

Dr. Colan—

Illness from scurvy, 9th April, on return from sledging, 1855-7.

Sir A. Armstrong—

Remarks on his case, 9253.

DOUBLE MANNING. [*See Sledging.*]

DRAKE, THOMAS, Private R.M. of "Discovery."

Dr. Coppinger—

A marine who chewed tobacco, did not suffer from scurvy, 2958-61.

DRAUGHTS. [*See Ventilation.*]DRYING ROOM. [*See under Ventilation and Washing*]EGGS. [*See also Diet.*]

Sir G. Nares—

No supply of eggs or birds, 36.

Captain Stephenson—

No eggs obtained, 307.

Captain Markham—

No preserved eggs taken, 699; possibility of taking a stock, 700-708; taken when he went in 1873, 704; advantage of taking them, 708.

Mr. Ede, Assistant Surgeon—

Quantities of eggs obtained, 4127-30; value of eggs as antiscorbutics, 4127; advantage of adding them to the diet, 4195; suggestion to preserve them with boiling vinegar poured over them after removal of the shells, 4195-9; ordinary eggs would not taste as nice after being kept some time, 4200.

Dr. Lyall—

Eggs will not keep very long at sea, 4396-7; does not recommend taking them, unless preserved in better ways, 4398.

Dr. Buzzard—

Their value, 5476-7.

Vice Admiral Ommanney—

A few obtained, 5852; others perhaps carried at starting, 5852.

Dr. Barnes—

Less antiscorbutic than milk, 7082.

ELEPHANTIASIS—

Dr. Munro—

Elephantiasis amongst natives in India the result of starvation and imperfect food, 8586.

ELLARD, W., Private R.M. of "Alert"—

Dr. Colan—

Had been with Lieutenant Giffard and with relief party, 1949-56; became ill of scurvy after having returned three days, 1953.

ENTRY OF MEN. [*See Men, Selection of.*]EQUIPMENT OF SHIPS. [*For questions of Accommodation, see Ventilation. See also Sledging, as regards Sledge Equipments.*]

Subheads 1. Ships.

2. Sledges.

1. Ships—

Sir G. Nares—

He was responsible for equipment of both ships, 3; ships equipped under authority of Arctic Committee, 3.

Captain Stephenson—

Fittings of "Discovery" as perfect as possible, 436.

Lieutenant May—

Was satisfied with equipment of "Alert" on starting, 834.

Lieutenant Rawson—

Was satisfied with equipment of "Discovery," 1173.

Lieutenant Giffard—

Quite satisfied with equipment of "Alert," 1251.

Dr. Colan—

How far satisfied with "Alert's," 2172.

Dr. Moss, "Alert"—

How far satisfied with equipments, 2490.

Dr. Ninnis, "Discovery"—

Generally satisfied with equipment, 2738; frames for growing vegetables should be taken, 2738.

Dr. Coppinger, "Discovery"—

How far satisfied with equipment of ship, 2981.

Difficulties of navigation render larger ships inadvisable, 2913.

Captain Hamilton—

Believes ships not so well equipped as in his expeditions, and decks damper, 3024-7.

Admiral Richards—

"Alert" and "Discovery" appropriate for the work, preference for a ship smaller than "Alert," but difficulty in carrying provisions for three years, 3238; advantage

EQUIPMENT OF SHIPS. 1. Ships, *continued*—

of a smaller ship as to warming, and in ice navigation, 3238.

Sir L. M'Clintock—

A vessel of 600 tons best fitted for the arctics, 3403; a crew of sixty necessary for sledging, 3403; better to have the two ships together for extensive sledging, 3404; a supporting vessel necessary for safety, 3404.

Captain Allen Young—

To reach the Pole requires a crew of sixty men, and a vessel of corresponding size, 3771-2.

Sir A. Armstrong—

The ships of the late expedition the best equipped that ever left England, 9267.

2. Sledges.

Sir G. Nares—

Under his responsibility, 206-7; had recommendations privately from Sir L. M'Clintock, 206; did not diverge much from them, 208; what lamps and fuel were carried, 176-8.

Commander Beaumont—

Advantage of pitching a tent over the sledge at luncheon, 944; sails provided for sledge, 948; used with good effect, 949; occasions when used, 950; proposed improvement in sledge, 951-3; cooking apparatus very good, 951.

Lieutenant Rawson—

Alteration in cooking apparatus to improve feeding the stove, 1116-18.

Commander Aldrich—

Equipment same as the northern party except boats, 1271; minor alterations suggested in cooking apparatus, 1294; suggested alterations in sledge bearers, 1303; and in tent waterproof sheet, 1303; the dress good, except guernsey and drawers, 1303.

Commander Parr—

All the equipments good, 1451.

Lieutenant Egerton—

Sledge equipment satisfactory, 1567; cooking apparatus cooked too slowly, 1567-8; made a few small improvements, 1569.

Dr. Colan—

Not consulted as to their equipment, 1744; how far satisfied with equipment, 2172.

Dr. Ninnis—

Water-bottles carried in waistband of trousers frozen, 2726.

Captain Allen Young, "Fox"—

Had no tent, only sleeping bags, and dug holes to sleep in, 3778-80; snow too soft to build huts, 3785.

Rear Admiral Pullen—

Statement of, in his sledges, 6230.

ESQUIMAUX—

Sir G. Nares—

Scurvy among, 44-5.

Lieutenant May—

The Esquimaux showed signs of scurvy in first spring journey, 799; he had taken his lime juice regularly, 806; he did not recognise his symptoms, 809; he was a smaller eater, 827; no lime juice taken then, 827.

Commander Aldrich—

The Esquimaux felt the cold in autumn more than others, 1322; clothing had to be supplemented, 1324, 1387; Esquimaux most, 1387; Esquimaux sealskin dress never thoroughly dry, 1324.

Dr. Colan—

Antiscorbutics used by the Esquimaux, 2096; the Danish Esquimaux suffer from scurvy, 2103-4.

Dr. Moss—

The Esquimaux complained of cold and fatigue more than Europeans, 2466; Esquimaux free from scurvy when fresh meat is plentiful, and recover with an abundant supply, 2385; scurvy with them coincident with scarcity of food, 2437; his observations might be modified by other cases, 2386-91.

Admiral Richards—

Esquimaux do not engage in labour, except in pursuit of food, 3163; whether Europeans are more susceptible than Esquimaux to scurvy, 3163; has not heard from authentic sources of Esquimaux having scurvy, 3164.

Captain Hobson—

Never heard of Esquimaux having scurvy, 3441-2.

Dr. Lyall—

Has heard of Esquimaux having scurvy, 4329-30.

Dr. Macdonald—

Remarks upon the Esquimaux; their diet on reindeer and blubber, 4852-3; their stunted condition possibly due to absence of vegetables, 4852; their use of scurvy-grass, cranberries and sorrel, 4584.

Dr. Pavy—

Scurvy occurs amongst them in spite of fresh meat, 5155.

Vice-Admiral Ommanney—

They are carried off by some sort of epidemic, 5780.

Captain Feilden—

Advantage of their plan in eating snow, 6065-7.

Rear-Admiral Pullen—

They do not have scurvy, their diet fresh meat without vegetables, 6196.

ESQUIMAUX, *continued*—

Mr. Bayley, "North Star"—

Esquimaux in the neighbourhood, 6304, 6440; no signs of scurvy, 6308; illness of one from frost-bite, 6305-7.

Alexander Gray, Ice-quartermaster of the "Discovery"—

Saw no illness among Esquimaux, 7569; has not seen scurvy among Esquimaux, 7199.

Dr. Rae—

Esquimaux all live in the same house and sleep together, 8747; their friendliness to him and honesty, 8747; disbelief of their having injured Sir J. Franklin's expedition, 8747; they remove their coats when asleep, and lie close together to maintain heat, 8841; suspected cannibalism amongst them, 8861; no indication of scurvy amongst them, 8862; or phthisis, 8867; their diseases principally influenza, 8866; they eat reindeer stomach with its contents, 8786-89; what the contents and taste are, 8863-5; their diet, 8852-60.

Sir A. Armstrong—

They suffer from scurvy, 9040.

EXERCISE (including Sledge Training).

Subheads 1. General.

2. Recent Expedition.

3. Former Expeditions, &c.

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Memorandum of recommendations by the	Medical	No.
Director-General..	..	2
Winter routine of "Alert"	..	4
Daily routine of "Discovery"	..	11

Evidence.

1. General—

Commander Aldrich—

Definite work in air on floe before and after dinner preferable to walking exercise, 1303.

Dr. Macdonald—

Should be proportioned to the temperature and the individual, 4844; anything within exhaustion beneficial when temporary, 4844.

Dr. Guy—

Importance of training before long sledge expeditions, 5410.

Rear-Admiral Pullen—

Men in Hudson's Bay service employed as much as possible in winter, besides instruction, 6215.

J. Organ—

Too much exercise cannot be taken whilst men can stand outside, 6788; doubts whether enough was taken in recent expedition, 6785-7.

Dr. Barnes—

Training for sledging an advantage, 7149.

2. Recent Expedition—

Sir G. Nares, "Alert"—

Walking parties preparatory to sledging, 129; owing to calm weather, crew worked and were exercised outside every day but two; afternoon work given up in severe cold in March when sledges were preparing, 9303; the walking and dragging training of "Alert" was exactly the same as in "Resolute" and "Intrepid" before successful journeys, 9303, 9378, 9384-5; what the system was, 9378; five hours a-day exercise taken, 9385; dépôts were established, entailing heavy work to reach, 9368, 9384-5; and crew exercised in dragging boats over rough ice; the dog-sledge exercised for some weeks before starting as much as possible, 9303; exercise not logged on one or two occasions, 9310; dragging coal and otherwise as sledge training, 9311; men abundantly exercised every day, 9312; to what extent the cold in March hindered training, 9381; men frost-bitten at divisions, and afternoon exercise consequently given up for a few days, 9381.

Captain Stephenson—

Men outside the ship five hours a-day in winter, 367; exercise compulsory, 372.

Commander Markham—

Two hours' exercise compulsory, 744.

Captain Beaumont—

Exercise enforced on all, five hours during severe cold, 1176-7; was road-making and dragging as well as walking, 1177; description of the ice on which exercise took place, 1178; did not look for difficulties, 1178.

Dr. Colan—

A certain amount of exercise taken, 1633; but men greatly confined to the ship, 1634.

Mr. Busk—

Before sledging a longer period of gradual inurement to hard work should have been allowed after the winter, 5249, 5287; between the comparative inaction and their very violent exertions, 5287.

Alexander Gray—

The work enough, and plenty of amusement, 7316.

Thomas Rawlings—

Sledge crews were practised dragging loads before spring travelling, 7639-42; all the travellers were trained, 7714-15, 7816; the training was useful, 7818; the work not so heavy as in actual sledging, 7817; at least two hours' exercise outside compulsory, 7717-28, 7810-13; in addition to exercise on upper deck, 7721-2; and was taken

EXERCISE. 2. Recent Expedition, *continued*—

even in bad weather, 7719; most of the crew on deck or outside during the whole day, 7727, 7811; what the work and exercise was, 7811; it was taken even in very cold weather, 7813-14; sufficient was taken, 7815.

Color-Sergeant Wood—

He saw that everybody, idlers and cook, took the prescribed exercise, 7879-80; every one compelled to take exercise, 7878; the lower deck was cleared during the forenoon, 7877; he watched to see the men kept off it, 7881; arrangements for work inside and outside, 7883; the lower deck always cleared in the forenoon, not necessarily in the afternoon, 7882-4.

William Jenkins—

What amount of outside exercise he took, 8472-4; did not suffer from his duties, 8175.

Sir A. Armstrong—

The amount, as mentioned in evidence, sufficient to preserve health, 8967; sledge exercise in the spring desirable, 8968; assumption that regular exercise was not taken as it is not logged every day, 8969, 9061; was only for two hours a-day, and that not compulsory, but exceptional, 9061; nothing to show it was taken as recommended, 8968, 9271; a want of appetite points to want of exercise, and is unusual in polar regions, 9271.

3. Former Expeditions—**Dr. Toms**—

Men in his expedition went out after breakfast in usual walking dress, 3653.

Dr. Lyall—

Men sent out for exercise twice a-day, 4324.

Captain Hamilton—**Belcher's Expedition, 1851-2**—

No compulsory outdoor work but walking, drill, or training (letter of G. Murray), 2996.

Vice-Admiral Ommanney—

Outdoor work given to every one every day in "Assistance," 5811; the winter routine, 5737; open air exercise of the crew, 5737; every one three or four hours in the open air, including idlers, 5812; walking training commenced in March, with ten or twelve miles walk, 5810-12; and practice in sledging with ballast 5810-12.

Mr. Bayley, "North Star," 1848-49—

Had plenty of exercise, 6262; what it was, 6303; about four hours a-day, 6339.

"Assistance," 1852-54—

Walking exercise, 6524-7; and sledge training and dragging weights, 6524.

J. Organ, "Enterprise," 1848-49—

Work round the ship dragging ballast, harder in the "Enterprise" than "Resolute," but not harder than travelling, 6552-7; what exercise was taken, difference between "Enterprise" and other ships, 6806-7; about five hours a-day work out of doors, 6556.

"Resolute" 1852-54—

What the walking and training was in her or "Assistance," three or four hours of it, 6729-32; weather permitting, 6731-2; not stopped by weather more than twice a-week, 6735; began training as soon as day light thoroughly permitted, *i.e.*, the beginning of March, 6736-8; it lasted a fortnight or so, 6739; more training than in "Enterprise," 6807; outside exercise compulsory, darkness never prevented it, 6740-52; about four or five hours outside the ship through the winter, 6744, 6786; exercise and games on board ship when weather prevented going out, 6746-52, 6805; taken equally all the winter except with much wind, 6808.

Mr. Murray, "Enterprise," 1850-55—

About five and a-half hours a-day, 6919-20; the more the better, 6921.

Alexander Gray—

In merchant whalers some men would not go out, but felt scurvy in the spring, 7318-19; would sit all day long on their chests, 7374.

Dr. Rae—

He practised his men before starting, 8885.

Sir A. Armstrong, "Investigator"—

Five and a-half hours' daily exercise taken, 8939; daily exercise and hunting sufficient sledge training, 8970; to what extent men overtaxed their strength, 8971-2; hard work in hunting, 9208; inability of crew to work in 1852, 9219; in third winter only a few able to hunt, officers made a point of doing so, 9221-2.

EXHAUSTION AND FATIGUE. [*See Sledging, Health, Scurvy.*]**FOOD.** [*See Diet.*]**FOULKE, PORT**—**Sir G. Nares**—

Advantage, in exploration, of wintering in so high a latitude, otherwise Port Foulke preferable, 135.

FRANCOMBE, REUBEN, A.B., of "Alert"—**Sir G. Nares**—

Objected to lime juice, but was made to drink it, 57.

Color-Sergeant Wood—

Was allowed to drink his allowance half at a time, 7964-6.

Captain Markham—

Attack of scurvy, 596-7.

FRANKLIN, SIR JOHN—**Dr. Rae**—

Sledging to Boothia in 1853-54, brought back the first information about Sir J. Franklin, 8747.

Admiral Richards—

Possibility of crews having escaped had supporting ships been sent, 3240.

FRANZ JOSEPH LAND—**Sir G. Nares**—

Expeditions to Franz Joseph Land, &c., would advance knowledge, but doubts discovery of 400 miles of coast line on reaching the Pole, 9352.

FREDERIC the ESQUIMAUX of "Alert"—**Lieutenant May**—

Signs of illness the first spring journey, 799; had taken lime juice regularly, 806; was a small eater, 827.

Lieutenant Egerton—

The only case in Lieutenant Egerton's sledge, 1563; not severe, 1566; occurred in expedition to Grinnel Land, 1577; had not hard work, 1583; had been sledging before, 1585; wintered in "Alert," and been healthy, 1586-7; did not suffer cold, 1589; was clad as the others, 1590; his symptoms, 1598-602; never a strong man, 1599; continued work nearly the whole time, put on the sledge in hard travelling, 1603; had not recovered on return, 1605; remedies applied, 1606; no idea of its being scurvy, 1607; he took spirits, but was not particularly fond of them, 1608-9.

Dr. Colan—

His illness, 1904-9.

Captain Feilden—

He suffered badly from scurvy in May, 5975, 5995; but stated he would get the "Qvan" at Disco as an anti-scorbutic, 5976-80; he had it in April and again in May when sledging, 6005; had not been sledging before April, 6006; employed on regular ship work, 6008; was well on leaving in April, 6010; when lime juice was not carried, 6012; but not regularly on the sick list, 6009; it was a decided though not severe case, 6016-18; his symptoms, 6017, 6061; he merely managed the dogs when sledging, 6059-60; his symptoms appeared the day of leaving, 6062; he was not a great eater, 6064.

FROST-BITE—**Sir G. Nares**—

Instructions how to deal with frost-bites given, 245-6; after experience in autumn, but little frost-bite occurred, 245; they were occasioned by wet feet, 246; necessity of walking in pairs to guard against frost-bite, 247.

Captain Markham—

Crew healthy except frost-bites, 561.

Lieutenant May—

Was frost-bitten and lost a toe from going through the ice, 831-3; men frost-bitten in autumn sledging, 813-16; but continued working, 816.

Commander Beaumont—

Every one instructed how to deal with them, no cases occurred, 1194.

Lieutenant Rawson—

Illness of Petersen, frost-bite due to want of quick circulation, 1043-8, 1126; he being too old for the low temperature; his age, 1127; he was as well clad as the others, 1047; symptoms of his case, 1128-33; he had been in previous expeditions, 1132; was suffering from frost-bite, 1133; measures to protect him when taken ill, 1134.

Commander Aldrich—

No frost-bite in autumn, 1258.

Commander Parr—

Bad frost-bites in second autumn journey, 1419.

Dr. Colan—

What amount of frost-bite there was, 2037-8; slow circulation most liable to frost-bite, 2126.

Dr. Nimis—

Men returned in good health from sledging, except frost-bites, 2503.

Dr. Toms—

Men suffered slightly from it in sledging from "Pioucer," 3711.

Mr. Edc—

Some cases of it in "Assistance," 4171.

J. Organ—

Had to return from May sledge journey from "Enterprise" owing to it, 6624-7.

Dr. Buzzard—

Its occurrence in troops in the Caucasus, particularly in scorbutic men, 5495-6; conditions under which it occurred, 5497.

Vice-Admiral Ommanney—

Occurred sledging from "Assistance," 5755; not in winter, 5806; one man sent back, 5870; six cases of it, 5872-3, 5893; due to inexperience at starting, wearing leather boots, 5893.

Sir A. Armstrong—

On sledging parties in 1851, 9201.

GAME. [*See Meat.*]

GOOD, JAMES, Chief Petty Officer of "Alert"—

Commander Aldrich—

Symptoms and date of attack, 1344-5; attributed stiff legs to result of sledging, 1347; subject to diarrhoea, 1266.

GIRARD, DANIEL, A.B., of "Discovery"—

Dr. Colan—

Ill from scurvy after sledging, 1928-34.

HAND, J., A.B., of "Discovery"—

Commander Beaumont—

Case of scurvy, when noticed, 874, 982; he had wintered in "Alert," 982; when sent back with Lieutenant Rawson, and reasons for believing his case to be scurvy, 875-6.

Lieutenant Rawson—

Treatment, 1145; symptoms, 1146; death, 1080, 1090; wintered in "Alert," 1071.

Dr. Coppinger—

Symptoms noticed in the dead body of this man, 2916-18.

HEALTH AND WEIGHTS OF MEN.—

Subheads 1. Recent Expedition, and General.

2. Former Expeditions.

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Evidence.

1. Recent Expedition, and General.

Sir G. Nares—

Men paler after the winter, 126; paler than crew of "Resolute," 129; paleness inseparable from arctic winters, 126; pallor no special indication of weakness, 127; was occasioned by absence of light, 128; no means of judging of stamina, health apparently good, 129; fewer days' darkness would have conducted to health, 135; great cold did not distress the men, except sledging, 135; men not weighed on starting and return from sledging, 211; medical report made before sending men sledging, 238; junior surgeon of each ship sent for some way with sledge parties, 243.

Captain Stephenson—

Men in fairly good health during the winter, 345; believes pallor of crew increased as winter advanced, but darkness prevented its being noticed, 390; it was not accompanied with debility, 391, 406-7; but with daylight spirits and energy returned, 391, 408; no material difference in crew owing to absence of light, 406-8, 426; pallor attributable to absence of light, 425.

Commander Aldrich—

Low spirits sledging due to illness and fear of unfavourable comparisons, 1383; enthusiasm was great, and it aided them in their work, 1384-5; attributed illness of marines to strain of dragging from the chest, 1333, 1388; the men dragged from the shoulder, 1388.

Captain Markham—

Crew of "Alert" healthy through winter, though rather pale from its length, 536-7; was due to darkness, and appeared with officers and men, 681; health of exploring parties before the spring good, 560; except frost-bites, 561; in good health when crews started sledging, 569; two men sent back with supporting sledges by recommendation of medical officer, 573-6.

Commander Beaumont—

Men in good health and spirits when starting sledging, 958; no decrease of good spirits, when aware of sledging difficulties, 960, 963.

Dr. Colan—

What illness there was in the winter, 1621, 2063; health remarkably good, 1627-30; health good up to time of examination of men for sledging, 1628-30; men apparently healthy when they left, 2001; best health during the dark season, 1631-2; catarrh not of importance, 1621, 2039; increase of weight of men in arctic regions, 2027; weighed before sledging, 2030; absence of electricity no bad effect on the health in the winter, 2047; no difference in health between fair and dark men, 2049-50; was, personally, in good spirits and good health till disease broke out, 2079.

Dr. Moss—

Assisted in examining sledge crews, 2202; looked on men as in good health, 2203; with three exceptions, 2203-4; occurrence of cases of snow blindness, the symptoms, 2405-6; treatment adopted, 2408; had a doctor been with the parties, he would have detected the scurvy more, but could not have done much with remedies at hand, 2471.

Dr. Ninnis—

Men in good health, except slight frost-bites after autumn sledging, 2503; crew had good health till January, 2512; health of crew good in March, 2532; but men were anæmic when sun appeared, 2533; though otherwise

HEALTH AND WEIGHTS OF MEN.* 1. Recent Expedition, and General, continued—

cheerful, 2533; weights of men fell after sledging, 2552; how comparison was made, 2552; when he weighed the men, 2553; satisfied with health of men on joining, 2689.

Dr. Coppinger—

The health satisfactory in general at the end of the winter, 2832; the men were weighed on leaving England, and before and on return from sledging, 2880-83; the general result an increase in the weights before sledging, 2882.

Dr. Pavy—

The men of the expedition were picked men in point of health, 5147; underwent great hardships and labor in the autumn without illness, 5147; crew of "Discovery" apparently in good health on starting sledging, 5147.

Dr. Guy—

Weight of men not a really good test of the effects of dietary, 5415; faulty results from trusting too much to it, 5415; an infectious malady specially fatal with vitiated air, 5369; crews of late expedition had no such malady, and were lives well able to resist its bad effects, 5369-71; in Millbank the prisoners are confined in their cells separately, except for exercise, 5373-4; their health is not affected by confinement, 5375: the space the crews had in arctic ships inadequate to preservation of health, where there is much confinement, 5403; but not with outdoor work, 5403; in the arctic the conditions of outdoor life not sufficient, 5403-4.

Alexander Gray—

No weakness or complaint of work till stiffness began, 7444.

Thomas Rawlings—

Could not wish for a better crew, 7661; health good in autumn sledging except frost-bite, 7709-10: felt in perfect health before spring travelling, 7638; men started well and worked well, 7729-32; and were well when supporting sledges left, 7733; were very eager to push ahead, 7729.

Color-Sergeant Wood—

Quite strong when scurvy appeared, 7994.

Mr. Emmerson—

Piles produced by wetness from condensation of the carpet on the lockers in "Discovery," 8087; men did not suffer from wet beds, 8326.

Sir A. Armstrong—

The men of late expedition proved by medical examination to have been healthy, vigorous and fit for their work after the winter, 8979-82, 8983, 9124; but perhaps might have diminished vigor, 9124; the pallor shown incidental to arctic service, and not a sign of incipient scurvy, 8981-3; anæmia incidental to polar service after the winter, 8980; men fresh from England would not have been in better state for the work, 8984.

Dr. Munro—

Elephantiasis amongst Indians, the result of starvation and imperfect food, 8586; considers more than one disease may run a parallel course, 8589; occurrence of yellow fever in Bermuda, to what extent accompanying particular winds, 8609-10.

2. Former Expeditions—

Captain Hamilton, Belcher's Expedition—

Immunity from disease (letter of G. Murray), 2996; deaths from other causes than scurvy, 3013-15; "Resolute's" crew in excellent health when taken on board at Beechey Island, 3036.

Dr. Toms, 1852-54—

Health of "North Star" perfect, 3576, 3660-61; death of two men of northern division not from scurvy, 3576; man of Franklin expedition whose corpse was dug up, 3638-41; probably died of consumption, not scurvy, 3641; men in good health returning from sledging, 3598, 3698; when taken on board "Phoenix," 3600.

Dr. Scott, 1852-54—

Health of his men very good, 3910; of Belcher's expedition on leaving very good, some men could have stayed out, 3941; volunteered to do so, 3941; Sir L. McClintock volunteered, 3942.

Mr. Ede, 1850-51—

That of men in autumn journeys from "Assistance" very good before starting, 4064; and on return, 4067-8; crews in very good health on return, 4113; could have stood another winter, 4114-15.

Dr. Piers, 1850-54—

Good in "Investigator's" crew at end of first winter, 4449-50; death of Mr. Sainsbury, on board the "Resolute," in November, 1853, 4524-6, 4649; from consumption, 4656; advantage of keeping men hopeful, 4528; insanity of one officer, probably the effect of the voyage, 4549-50; imbecility of one man due to climate and insufficient food, 4551-2; inability of men to hunt in winter, 1852-3; owing to debility and depression, 4637-41.

Vice-Admiral Ommanney—

Pallor after the winter not very striking, 5814-15; health and happiness of men in "Assistance," 5898; sick list of ship very small, 5749, 5758; perfect health the whole time, 5756; men started sledging in perfect health,

HEALTH AND WEIGHTS OF MEN. 2. Former Expeditions, continued—

5752; and returned so, except for frost-bite and snow-blindness, 5755; no one on sick list, 5755; his list in July, 5871-3; crew quite able to undergo another winter, 5747; amputation of one man's great toe, 5894; the importance of ventilation, exercise, and regular hours for meals, 5782; was personally better on return from sledging, 5897.

Rear-Admiral Pullen—

Men in boat expedition from "Plover" in good health, 6161; also on return, he was sick after eating and had diarrhoea, 6116-17, 6178-9; health of crew of "North Star" bad, but not from scurvy, from the difficult position of the ship, 6210; and hard work, 6211; changed the crew when "Phoenix" arrived, 6212.

Mr. Bayley, "Assistance," 1852-54—

Very good health during sledging, or at least able to do work, 6293-5, 6397-9; suffered from snow-blindness, 6294; what the health was and appetite in his journey, 6397, 6434-5; a little weaker on return from longer journey, two days' rest given, 6411; injurious effects of cold on his third journey, 6417-35; inability to eat, 6422; suffered from intense cold in the inside, 6423; abandonment of sledge, 6421; remained some days in "North Star," and completed journey in good health, 6427-35.

J. Organ, "Assistance," 1852-54—

One or two men had swelled legs when sledging, 6561; remained with one in a snow hut at Cape Lady Franklin Depot for twenty days, 6562-70; health at end of winter very good, no illness, 6661-3, 6687; heard of no symptoms of scurvy in any sledging party, 6675-8; two men died, 6685-6; not of scurvy, 6688; men in 1854 returned in good health, 6717; health better on last than on first voyage, 6574-6; was willing to remain another winter, 6581.

"Enterprise," 1848-49—

Several sick, 6542; unaware of any cases of scurvy, 6540-43, 6610-17, 6809-11; men suffered from damp, and there were a few colds, 6588-9, 6610; men were in good health at end of winter, 6610; how his case was caused, 6633; illness of twelve men out of forty of the sledging party, 6636-43; due to heavy snow travelling, 6641; sick men were sent back by depot sledges, 6643-4; and soon got fit for work, 6649; the rest returned in good health, 6646-9; never heard of the disabled men having scurvy, 6651.

"Resolute," 1850-51—

One death from frost-bite, 6818.

Dr. Rae—

Men of Sir J. Richardson's expedition, 1848-9, healthy after a winter on solely carnivorous diet, 8717, 8721, 8829; the men who lived on fish looked healthier but were not so wiry as those who lived on meat, 8829; in 1845-6, in his sledging expedition the men had improved in health on return, 8722; in 1850, health excellent, 8736; reached Minesota in perfect condition, taking care not to overwork themselves, 8746; 1853-4, men perfectly sound, except one man suffering from frost-bite, 8747.

Sir A. Armstrong—

Health in "Investigator" fell off after second winter, and reduction of provisions, 9025; it was good on arriving at the Sandwich Islands, 9189; parties in good health in return, especially one which had fresh meat, 9204; inability to do hard work in 1852, 9219; improvement on board the "Resolute," 9225-30; Sir L. McClintock's sledge crew on return to "Resolute" much broken, 9232-34; "Investigator's" crew in almost as good health as the "Resolute's" the last year, 9238; except a few cases, 9238-39.

HEATING AIR. [See Air, Ventilation.]

HEIGHT. [See Men, Selection of.]

HILL, ELIAS, Gunner, R.M.A.—

Commander Aldrich—

Sent back to H.M.S. "Alert" from sledging the eighth day by advice of the surgeon, 1261-2; attributed illness to method of dragging, 1332-4.

HINDLE, ALFRED, A.B., of "Discovery"—

Dr. Ninnis—

Scurvy of Alfred Hindle, after sledging in North Greenland, 2560-63.

HUDSON'S BAY. [See also Selection of Men.]

Dr. Rae—

Scurvy only appears at York Factory, owing to diet being chiefly salt meat, 8794-8800, 8815-16; preserved potato and cranberries issued when there is not enough fresh meat, 8796-7; the scurvy generally appeared in absence of fresh venison, 8816; there is a garden at York Factory, 8795.

Rear Admiral Pullen—

Stations of people at Fort Simpson and the Great Slave Lake, 6142-5; a patch of ground cultivated at Fort Simpson, 6137, 6147; potatoes, barley and turnips grown, 6148-9; some men in the service capable of eating large quantities of meat, 6151-2; twenty pounds a-day eaten by one man, 6151; scurvy was unknown at the stations, 6144, 6197.

HYGIENE. [See Ventilation, Air.]

ICE, ICE-FOOT, ICE-FLOES. [See also Sledging.]

Commander Aldrich—

Ice between the "Alert" and Cape Joseph Henry broken and hummocky, afterwards smooth, but heavy hummocks north of the land, 1277; the crushed ice may move with the currents, 1278; the floe does not move, and a ship could not navigate round the north coast, 1278; no ice-foot existed except near the ship, 1279-81; to what extent it may exist in summer, 1282; the cracks in the ice small and deep, 1287-8.

Lieutenant Egerton—

What amount of ice-foot there was, 1514-5.

Captain Hobson—

Inside the broken-up ice, near the land, there is generally a comparatively easy coast line, 3409.

T. Rawlings—

Often in sledging unable to go round the hummocks, 7821-3; the height about fifteen feet, 7824.

"INTREPID," H.M.S.—

Sir G. Nares—

Used as hospital ship, 9303.

"INVESTIGATOR," H.M.S., 1850-54—

Captain Hamilton—

Ship's company splendid, 3037.

Dr. Piers—

Passed the first winter in the Prince of Wales' Strait, 4445; and left a dépôt in the Princess Royal Islands, 4446; where they spent their winters, 4480.

Sir A. Armstrong, "Investigator"—

Account of voyage in 1850, 8931; hardships in working through the ice on the North American coast, and in Prince of Wales' Strait; first winter at Princess Royal Isle, during this winter in a perilous situation, 8931, 9193-4; ship drifting in the ice till October, 9195-6. In 1851, arrival at Baring's Island and Mercy Bay, second and third winters passed here, being unable to extricate themselves, rescue by Lieutenant Pim travelling in very low temperature, 8931, 9223; the fourth winter spent on board the "Resolute" and "Intrepid," journey to Beechey Island in 1854, 8931; his offer in 1851 to communicate with Melville Island, suggestion not carried out, 8937-8; what degree of cold was experienced, 8965-6; hardships and labour in voyage to Mercy Bay, 9206-8; labours subsequently confined chiefly to hunting, which often caused exhaustion, 9208; abandonment of the ship, 9224.

JONES, FRANK, Stoker of "Discovery"—

Dr. Ninnis—

Illness from scurvy after sledging in North Greenland, 2574-6.

JOSEPH HENRY CAPE—

Sir G. Nares—

Navigable water will never be found north of Cape Joseph Henry, 9351.

JOURNEYS. [See Sledging.]

KEMISH, GEORGE, Wardroom Steward of "Alert"—

Dr. Colan—

Lime juice was supplied to him before his attack of scurvy, 2118; his illness, 1710; beginning in January, 1712; suffered from debility, induced by drinking, 1713-14, 1727-8; his symptoms, how far scorbutic, 1715-27.

Dr. Moss—

Dyspeptic and irritable, 2228; did not consider him to have scurvy, 2230.

LARD—

Dr. Moss—

Benzoated lard taken as a protective against cold and sun, 2440.

LECTURES—

Commander Aldrich—

Lectures Sir G. Nares gave upon sledge travelling, 1348; what points he touched on in them, 1350.

Sir G. Nares—

Lectures he gave before leaving England on arctic service, 9370-71; contained no allusion to scurvy, 9372; the lecture he gave the men on the work they had before them, 9347.

LEPROSY—

Commander Cameron—

In his journey across Africa, heard of a place supposed to be leprous, attributable to the water, little communication held with it, and the people not allowed to leave their country, 4820-22; the leprosy well known to Arabs, and is not scurvy, 4824.

LIGHT, ABSENCE OF. [See Darkness, Health.]

LIME JUICE. [For question whether taking it would have averted Scurvy in the Recent Expedition, see under Scurvy. Under Subheads 2 and 3 will be found some opinions of officers as to taking it sledging, &c.]

Subheads 1. General.

2. Recent Expedition.
3. Former Expeditions and Voyages.
4. Merchant Service.
5. Carrying it Sledging or Concentrating it.

LIME JUICE, *continued*—*Papers in Appendix, and with Report, &c.*

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Evidence.

1. General.

Sir G. Nares—

It is dispensable as a ration, 85-6; was sensible of its value, 213-14; craving for it by arctic travellers, 181, 201; the suggestion of mixing it with pemmican excellent, but it should have been made before leaving England, 9303.

Captain Stephenson—

How far it is a curative as well as a preventive, 471-2; has proved an excellent antiscorbutic for the navy, 499, 500; freezing does not destroy its power, 531.

Captain Markham—

Has taken it as an antiscorbutic, 673-4; does not attach value to its supply, 670, 736; or consider it a preventive, 671.

Lieutenant Rawson—

How far a good antiscorbutic, 1142.

Dr. Colan—

Description of its preparation, 1763; what its constituents are, 1767; is essential in absence of fresh vegetables, 2081; does not fortify against future invasion of scurvy, 2082-3; effect of an increased allowance, 2084-5; effect of freezing, 2115.

Dr. Moss—

The most powerful antiscorbutic next to fresh vegetables, 2423.

Dr. Ninnis—

Is the best prophylactic that can be taken sledging, 2706; the best substitute for but inferior to fresh vegetables, 2704.

Dr. Coppinger—

Recommends daily administration, 2793; is of great value as a prophylactic, 2926.

Captain Hamilton—

Attaches importance to it, 3082.

Admiral Richards—

Would carry it, if thought necessary, and it could be used, but never experienced want of it, 3228-31.

Sir L. McClinton—

It is desirable without game, not necessary with it, 3395.

Captain Hobson—

Necessary in arctic expeditions, 3538.

Dr. Scott—

No expedition should be without it, should be taken constantly, 3953; at sea issued after ten days on salt provisions, 3961-4; it tends to preserve health, 3965; its beneficial effect not confined to on board ship, 3975; attaches value to its curative effects, 4024; it is a valuable and indispensable agent as an antiscorbutic, 3971, 4026-30; especially in arctic ships, 4029; immunity of royal navy greatly due to it, 4027.

Mr. Ede—

May or may not be diluted, 4166; was generally diluted, 4167-8; it would not produce mucous irritation in healthy people, 4170; sugar increases its antiscorbutic properties, 4241; prefers it liquid with water, 4243-4; its great value as an antiscorbutic, 4249; it is a necessary article of sledge diet in absence of fresh vegetables, 4250.

Dr. Lyall—

Useful as an antiscorbutic, 4306, 4416; but will not prevent scurvy altogether, 4306; taking it sledging is of great moment, 4421; objection to taking it undiluted as injurious to the mucous coat of the stomach, 4308.

Dr. Piers—

It is an advantage to take it sledging, but well trained men might go through a long journey without it, 4553-4; its effect would not last long after its discontinuance, and the blood would deteriorate, 4670.

Commander Cameron—

Fresh limes had at Benguella instead of lime juice, 4806.

Dr. Macdonald—

Benefits of lime juice as an antiscorbutic, 4855; its active principle the vegetable acid, 4855; or the citric acid, 4857; in favour of lime juice pure, therapeutic agents being most effective in their natural combinations, 4859, 4888, 4899; history of the introduction of lime juice, 4899, 4900; examination made by him of the lime juice supplied to the expedition, 4913; acidity, 39.2 grains of citric acid per ounce, 4913-14; this was above the Board of Trade standard, 4914: lime juice freezes at + 25, when unfortified, 4936; and fortified at +15, 4936; a greater porportion of spirits would stop freezing and prevent breakage of bottles, 4936; without great increase of bulk 4937; extract of lime juice with equal bulk of

LIME JUICE. 1. General, *continued*—

spirit would not freeze, 4949; and it could be carried in arctic temperatures, 4950.

Dr. De Chaumont—

Introduced as a substitute for vegetables, as having large quantities of vegetable acids, 4979; is the best antiscorbutic, 5056; the potash and phosphoric acids in it not the cause of its efficacy, 4980-81; contains much citric acid, 4982-5; experiments on freezing it, 4986-92; no difference between the fortified and unfortified, except as to point of freezing, 4987; no alteration in the acidity, 4992; experiments on reducing to small bulk, no change in its chemical constitution or diminution of acidity, 5104; it can be evaporated to dryness, and an ounce reduced to fifty grains weight, 5105-6; addition of sugar required to correct acidity, 5109.

Dr. Pavy—

The most convenient substitute for fresh vegetables, 5154; prefers lime juice to preserved potatoes, 5237; it should be taken as a whole, without one particular principle being regarded as the active agent, 5242.

Mr. Busk—

Two ounces should have been given in the winter and taken sledging, it being essential, 5249, 5257; especially so under the conditions of the sledge journeys, 5259; sledge journeys should not be undertaken except under necessity, if it cannot be taken, 5249; difficulty of ascertaining in what antiscorbutic properties lie, 5265; the frozen lime juice of the "Polaris" did not deteriorate, as shown by its effects on Beaumont's party, 5267; lime juice, in the absence of fresh vegetables, the best remedy for scurvy, 5269.

Dr. Guy—

An acknowledged antiscorbutic, 5319; one of the best, 5383; all its constituents useful, the vegetable acids most important, 5320; water no value, except as a solvent, 5321; is not a perfect substitute for vegetable food, 5347; it should have been taken sledging, 5388.

Dr. Buzzard—

May be considered a fresh vegetable food, 5435; instances of rapidity of its effects as a curative, 5451; its efficacy as a preventive very great, 5451; in sufficient quantities will prevent scurvy, 5451; the one-ounce a day in the merchant navy sufficient with present voyages, 5451, 5455; lime juice not a specific against scurvy, it is convenient, but inferior to natural diet, as potatoes, 5478-9; antiscorbutic properties of lime juice lies in citrate and malate of potash, and citric and malic acid, 5504; combination of these elements constitutes its efficacy, 5505; would prefer two ounces of lime juice as a ration, 5517; the proportion in the arctics should be adjusted by the medical officer, 5518; what quantity might be taken without injury to the men, 5519-20, 5530-33; possibility of a large dose interfering with digestion, 5533; it should be carried sledging, 5521; the ration should depend on the medical officer's observation, with regard to demands on the system by exertion, 5522; and be more taken travelling than on board, 5523.

Mr. Leach—

Occurrence of scurvy with good lime juice, but bad or insufficient animal food, 5544-8; decrease of 70 per cent. in mercantile marine since the Act of 1867, assuring its quality, 5541; character previous to 1867 glaringly defective, 5556; one third of shipowners use lime, two-thirds lemon juice, the latter used in consequence of insufficient supply of lime juice, 5557; lime juice the most antiscorbutic, 5558; the citric acid varies with the time of picking the fruit, 5559; the juice is examined under Customs' arrangement in bond at the Inland Revenue Laboratory, 5561-3; it is certified and fortified, sealed and issued only for seagoing purposes, 5564-7; the limes chiefly come from Montserrat, the lemons from Sicily, 5570; it is not highly thought of or used in the United States, 5572-3; is the most efficacious antiscorbutic substitute for vegetables, 5599-601.

Dr. Dickson—

It keeps better than cranberries, 5720; is essential as an antiscorbutic in the absence of fresh vegetables, 5631; lemon juice made by wholesale confectioners in London, 5632; lime juice imported from West Indies, 5632; lime juice more grateful, but little difference in their dietetic properties, which depend on the fruit when picked, 5633; the ripe lemons having less property, 5722; easily tested without chemistry, 5690; the acid is the important element in lime juice, but in inseparable combination with other matters, 5691-2; possibility of abstraction of water from it, 5693; the same amount should be taken sledging as on board, 5707-10; an ounce a-day adequate, 5709; amount of citric acid in the merchant navy juice superior to some of the navy, 5722.

Captain Feilden, R.A.—

Is a valuable antiscorbutic, 5955, 6069; question of its freezing in extended sledging, 5954.

Mr. Bayley—

Has a good opinion of it, though he seldom drank it, 6522; it was given to prevent scurvy, 6523; no reason for not

LIME JUICE. 1. General, *continued*—

taking it except distaste, did not take it on the coast of Africa, 6195-6.

J. Organ—

Every one should take it, enforced its being taken, 6583, 6820-21; considered it would prevent scurvy, 6813-23; has always taken as much as he could get, 6824-5.

Mr. Murray—

Advantage of its being a ration in the winter, 6933; is a good thing to use and a preventive of scurvy, 6954-5; was served out in the navy after fourteen days' salt food, 6955; puts more faith in vegetables than lime juice, 7017; never saw any carried sledging, 6875, 6968; would not take it sledging, 6932-4, 7019; might be advantageous to take it in a condensed form, but they never thought of taking any, it not being necessary, 6934-8, 6969.

Dr. Barnes—

The most valuable and effective substitute for fresh vegetables, 7034; it supplies a want of vegetable food, 7111; introduction in 1795, 7036; to what extent sudden abstraction of it is hurtful, 7112; the double allowance given before sledging very judicious, 7119; too much heat would impair antiscorbutic power, 7131; an ounce and a-half a-day ration should be taken sledging, 7137-8; the ration in late expedition should be increased, 7139-40; its virtue depends on the combination of its constituents, 7150; its water non-essential, 7151; extracts may be found by experiment to be valuable, 715.

Dr. Munro—

Lime juice not provided in the army, 8525; not sent to the army in the Crimea in 1854-5, 8539-42; did not use it in his treatment of the cases there, 8553; in Indian cases lime juice would not have cured the men without other adjuncts, 8571; it has been given in the ships he has taken passage in, 8596; lime juice an antiscorbutic, 8614-15; it has been beneficial, 8687-8; and is valuable in scurvy, 8689; lime juice or vegetables should be given in every dietary, 8690-94.

Dr. Rae—

Hudson's Bay Company only keep it at York Factory because there are no vegetables, and the diet is chiefly salt meat, 8759; had but little lime juice when the outbreak of scurvy he witnessed occurred, 8768-71.

Sir A. Armstrong—

It will not lose its antiscorbutic properties by keeping, 8990; or by freezing, 8991-93; or change of temperature, 9107, 9108; analysis of that of the "Alert" and "Discovery," the soundness of the samples, 9109; it is the best substitute for fresh vegetables, 8994, 8995; more a food substitute than a medicine, 9110; is only a substitute, and not so efficacious as fresh fruit or vegetables, 8997; was not carried on former long journeys, 9175; suggestion to mix it with rum, tea, or pemmican, 9008, 9016, 9093; at the time of using only, 9177, 9093; an ounce a-day enough, 9015; other articles might be dispensed with rather than it, 9016; no diminution takes place from length of administration in its prophylactic powers, 9024; would not increase it except if disease breaks out, 9024, 9112.

2. Recent Expedition—

Sir G. Nares—

Would not substitute lime juice for rum, 200; gratitude of Inspector of North Greenland for present of, 45; was strictly given on board, and doubled previous to crew starting for and returning from sledging, 55; was generally liked, 56-7; taken in presence of an officer, 64; ration was one ounce, 62; doubled from 1st March, 1876, 63; extra ration was sent to messes, 65; all of officers was sent to mess, 65, 66; not considering it necessary to make taking it compulsory, 69; reasons for doubling allowance, how far a medical precaution, 67, 71, 79, 80; not so, 9357-8; believes it was all consumed, 68; no reason to consider the extra ration injurious, 73; consulted the medical officer before doing it, 74; it was never frozen except in sledges, 75, 9303; how carried or kept, 76, 82; one man who refused it moderately cheerful, 77; the extra allowance a pleasure, 76, 935-8; one ounce enough for a general issue; sick had three or four ounces, 81; a good deal of spirits mixed with it, 83; a large quantity returned into store, 88; not taken sledging during cold weather, 164, 167, 169; reasons for not taking it, 170, 172, 179; additional time lost in preparing it, and bad effects on the men of the halt, 179; one lamp not enough if lime juice was taken, 178; arrangements for sledging and weights must be altered if taken, 179; considers it now an essential article of sledge diet, 178, 180, 200; might be issued in lieu of evening tea, 180; could not have been substituted for rum, 184; weights, if substituted, about the same, 185; including sugar, 212; extra water must be thawed for it, 188; how far practicable to add it to tea, 189; comparison with other sledge parties, showing if lime juice was used, 203; was sensible of its value, if it could have been carried, 213-4.

The Medical Director-General should have given reasons

LIME JUICE. 2. Recent Expedition, *continued*—

for change in sledging by introducing it, 9303; would have sent it sledging but for the fuel, it had been issued for sending out to western party before scurvy began, 9304; objects to mixing it with tea, but concurs as regards pemmican, 9305-6; no difficulty in doing so, 9307; recommendations of Sir Alexander Armstrong as to taking it sledging could be only suggestions of an arctic officer, without reasons being given, 9324; a good reason should be given for change of system, 9328; Sir Alexander Armstrong could not have entered into the question in his book, 9325; there being no evidence as regards it in previous sledging parties, 9327; they having performed successful journeys without it, 9331; the small amount taken by the northern party sent on chance of some slight scorbutic taint, 9363-4; but without dread of a severe case, 9363; regrets it was not sent if it would have kept off scurvy, 9365.

Captain Stephenson—

One ounce of it given daily on board "Discovery," 286; to what extent increased, 287-8; double ration after 9th August, 1876, 324; on recommendation of medical officer, 324-5, 329; not previously increased as a general ration, 327; after 30th September, 1876, increased to three ounces per man, 322; issued twice a-day, 334, 520; not considered necessary when sledging, 358; recommendation of Medical Director-General as to issue carried out on board, 362; and as far as practicable, 458-9; how drunk, always at the tub, except officers, 363-4, 519; in presence of the officer of the day, if possible, 365; not declined by any one, 365; was popular, 519; was taken by the man ill in the winter, 417; not taken sledging, owing to difficulty of carriage, 441, 470, 476; not then considered necessary, 465, 476, 497; how far the question of taking it was considered, 442; no mention of it in medical sledging instructions, 451; question of taking it on sledging did not attract attention so much as in England, 464; did not then think it so essential as he now does, 496; did not attach same importance to it as Medical Director-General, 470; thinks now it should be carried in sledging, 471, 492; might have been carried as a preventive, 475; was of use to sledging party at the Polaris depot, assisting in curing scurvy, 479-80; could have carried it late in the year, 510; not earlier, for use, 511; that left by Polaris made use of, 508-9; description of it, how left, &c., 512-14; five years uncovered, 526-7; proved efficacious, 530; taking it would have involved extra fuel 518; objections to taking it in tea, 522-4; would be enforced if necessary, 525.

Captain Markham—

Treated cases of scurvy with it, 608; what amount he had taken, 609-10; reasons for taking it, 611-12; considered it an excellent antiscorbutic, 613; was not a daily ration, 614; bottles not protected from the cold, 618; first bottle broken in attempting to thaw lime juice, 620; quarter gill given to men with scorbutic symptoms, in lieu of grog, 622, 737; he supplied two or three, 652; stock was finished 18th May, 628; again administered on arrival of relief party, 636; had melted it in his sleeping bag by placing it between his legs, 644; difficult to thaw even a small amount, 646; most of this the spirit, 646, 755; impossibility of so obtaining daily rations of it, 648; owing to temperature having been too low in April to thaw it, 649-50; in May, or with smaller bottles, more could have been thawed, 651; objection to mixing it with tea, 763; on board ship taken by every man at the tub, including ice-quartermasters, 783; would not carry it sledging, 672; has taken it on board ships as an antiscorbutic, 673-4; no craving of the men for it, 683; but taken with relish, 684; given in usual way, 685.

Lieutenant May—

Took it last three spring journeys, 793; what proportion, 824; a double allowance the last journey, 793; temperature then admitting of carrying it, 794; issued it regularly, 795; at what time, 796; useful in preventing scurvy, 805; none taken when sledging in autumn, 817; not taken in early spring, owing to cold and weight, 817; liking of men for it, 820-4; easily served out, not being frozen, 825-6.

Commander Beaumont—

Did not have it sledging, till he got to Polaris Bay, 892, 937-9; then used that left by "Polaris," 893-7; found it good, 894; how far it was beneficial, 898-900; it had been found frozen, and did not become strong till a general thaw took place, 1001; not taken when crossing from Thank-God Harbour to Cape Baird, 924; how stowed at Polaris Bay, 945; eagerness with which it was taken, 990-91; disappointment at want of anticipated effect, 990; whether lime juice would have averted or delayed scurvy, 1000.

Lieutenant Rawson—

"Polaris" lime juice supplied on arrival at Thank-God Harbour, 1080; the condition it was in, and how got out of cask, 1081-5, 1138-40; took it on expedition to relieve Lieutenant Beaumont, 1094; did not carry it on leaving "Alert," 1112; took it on board, 1141; advant-

LIME JUICE. 2. Recent Expedition, *continued*—
age of it at Thank-God Harbour, 1143; men glad to get it, 1144.

Lieutenant Giffard—

It should be taken sledging, 1221-27, 1233; being a good antiscorbutic, 1223; took it on his second journey, 1222; the sick men asked for it, 1224; supply of it to them, 1225; but did not improve, 1226; would not substitute lime juice for spirits, 1234; an ounce of lime juice the daily ration, 1235; the men did not care much for it, 1236; lime juice had been taken by the men before they fell ill, 1239; but they had been on previous journeys without it, 1246.

Commander Aldrich—

Did not take it sledging, 1271, 1289; whether it should be taken, 1273, 1372-7; objection to it in the tea, 1297; a ration is about two table spoonsful, 1299; gave it after finding it at depôt, 1355-6; what amount he found, 1359; its condition, and the temperature it had been subjected to, 1360-62; being liquid, it only required thawing water to mix with it, 1379; it was not weaker than the ordinary, 1399; personally took it after finding it at the depot, 1367; limitation to carrying antiscorbutics, if their use interferes with the journey, 1377; no experience of it as the sole antiscorbutic, 1378; was taken at sea, but has been seldom long without fresh vegetables, 1378; in "Challenger" it was given after four days at sea, 1394-5; it was taken with pleasure by sick men, but did no good, 1397; how he managed his issues; gave over the ration, 1398; recommends it being taken; doing so might shorten the journeys, 1400.

Commander Parr—

What they had on northern party, 1431, 1446, 1482; the bottles, how carried, 1481; the neck of one broken, 1484; it was intended for the sick, 1447, 1487; used when symptoms proved to be scorbutic, 1432; difficulty in thawing it, 1433; how administered and when, 1434; how long continued, 1435; none found at depot on return, 1436; it should be a daily ration when sledging, 1438; mixture with tea unpalatable in the necessary quantities, 1462-3; men glad to get it when they knew they had scurvy; no craving for it with one man who disliked it, 1522.

Lieutenant Egerton—

Used an ounce daily per man on inland trip, 1558-60, 1595; it was regularly taken by the Esquimaux who had scurvy, 1564, 1593; taken by Esquimaux from day of starting, 1594; did not take it till May, when it did not freeze, 1570; when and how it was given, 1596-7.

Dr. Colan—

One ounce taken daily, 1678-9; ration doubled in March before sledging, 1680-82; was not consulted as to increase, 1683; did not object to it, 1686; had plenty of opportunity to do so, 1687; was thoroughly satisfied with the quality of the lime juice, 1703; it was good all through, 2094; lime juice most useful in sledging, 1761; if necessary should be sent instead of rum, 2092; it should be sent, 2158; was aware of exclusion of lime juice from sledge dietary, 1751; was not consulted about sending it, 1753; suggested its being sent, 1756, 2175-6; gave no reason for doing so, 1759; understood it could not be sent, unless other essential things were left out, 1756-60, 2055; did not see means of remedying objections to its weight, and that of fuel for melting it, without reducing extent of travelling, 1762; found that supplied good, except one jar, 1764; its colour and taste, 1765-6; treatment of sick with it, 1700-8, 1720-21, 1824, 2118; up to three ounces a-day given in treatment of some patients, 1993-6, 2071; men mended under it, 2071; absence of it when sledging, may account for scurvy, 2013-14; difficulty of taking it sledging, except in small quantities, 2015; it might have been taken instead of sugar, 2016; it should be sent sledging, 2092; objection to mixing it with tea, being unpalatable, 2162-3.

Dr. Moss—

Not taken in autumn sledging, 2200; case of G. Burroughs, no suspicion of his not having taken lime juice, 2211-12; was employed in serving it out, 2211, 2218; it was given in presence of an officer, 2220-22; was taken by the men during the winter, 2454; how far taken sledging, 2321; examination of, for acidity, the result, 2324-9; account of analysis, 2328-9; it contained alcohol, 2331; general appearance good and clear, 2333; sugar not a necessary, but a customary addition to the ration, 2346-8.

Dr. Ninnis—

Precautions to enforce every one drinking it, 2530; men relished it and would have liked more, 2530; it was not taken sledging, 2645; he advised its being taken, 2646-7; discussed the question with the captain, but did not urge it as of vital importance, 2722; it should always be taken, 2705; an ounce a-day, 2736; it was given to invalids as soon as they came under medical care, 2658; objections to thawing it in tea, as unpalatable and cooling the tea, 2664; from two to eight ounces a-day given to sick, 2695-6; eight ounces taken readily, 2697; how the lime juice was administered, 2698; bene-

LIME JUICE. 2. Recent Expedition, *continued*—

ficial effect of administration, 2699-2700; would now press it as a necessity, 2723; unpalatable in tea, and difficult to thaw, 2725; difficulty of thawing it in sleeping bags, 2726.

Dr. Coppinger—

Carried it on two expeditions, not as a regular ration, 2770-71; but for treatment of Frank Chatell, 2772-3; he having shown signs of scurvy, 2796-8; administrations to him not so effective as if daily, 2794-5; he had had it previous to illness at broken periods, 2786-90; scurvy was not prevented by it, 2791-2; taken also for relief of Lieutenant Beaumont's party, 2774; was issued as a regular ration during stay at Polaris Bay, 2775; not to Lieutenant Beaumont's crew between 20th April and 25th June, 2777; the lime juice used at Polaris Bay belonged to the American expedition, 2885; had been lying in a pile of casks in the open for five years, 2886-8; it was used in eleven cases of scurvy, 2892; and was good, 2894; invalids recovered under it more rapidly than Shepherd under the navy juice, 2897; description of its condition, 2898-9; to what temperature exposed, 2901; the casks exposed to sunlight, 2902; the upper portion watery, 2903; the remainder efficient, 2904; he obtained at Polaris Bay that he took sledging, 2923; took it on his own responsibility as a curative, 2924; it is advisable to take it sledging, 2925, 2933; possibility of thawing it in the sleeping bags, 2963; objections to doing so, 2967; would have been unpalatable if mixed with tea, 2965-6; its want of effect in certain cases (till fresh meat was obtained), 2974; ration sledging should be one ounce a-day, 2979.

Dr. Macdonald—

Examination of it, 4913; amount of acidity, 4913-14.

Dr. De Chaumont—

Showed 39.2 grains of citric acid, 4982-5.

Dr. Pavy—

A larger allowance should have been given on board ship, 5172-3, 5180-81; the allowance was doubled or more at times, 5173-5, 5180-1; no fear of prejudicial effect on the digestion or otherwise, if two ounces had been given, 5181-2; the sledge dietary deficient in it, 5233.

Mr. Busk—

Two ounces should have been given in the winter, and taken sledging, it being essential, 5249-57; especially so under the condition of the sledge journeys, 5259; the amount given in winter quarters was hardly enough to prepare the constitutions, 5258.

Dr. Guy—

The defect in the sledging dietary might have been partially remedied by lime juice, 5346, 5388; it should have been taken sledging, 5388; more than one ounce, 5391; the one-ounce daily ration on board ship should have been increased, 5392-3.

Dr. Buzzard—

The ration not quite sufficient to preserve the working capabilities of the body, to the effects of this, and its absence when sledging, the scurvy was due, 5454, 5457; the double allowance on board the "Alert," 5458-60; recovery of the men due to it, and consequent probability of the juice being good, 5455; its omission from the sledge diet of serious importance, 5485.

Mr. Leach—

Importance of its omission from the sledge dietary, 5599.

Dr. Dickson—

Should have been taken sledging, 5622-24, 5707; instead of rum or tobacco, 5625; being more essential, 5684-5; one ounce a sufficient ration, 5665.

Captain Feilden—

Took it regularly on board ship, would have liked more, 5938-9; an ounce a day, doubled on return from sledging, 5949; little difficulty in obtaining more when returning south, 5949; taken by the men at the tub in presence of an officer, 5950; the extra issue to the messes was drunk, the men liked it, 5951-2; took it sledging except when the temperature was low, 5937-41; doubts whether it was not taken then, 5989-90; able to take it in April, it could be used without thawing, 5985, 5992, 6019; one ounce used, 5993-4; in what expeditions he carried it, 5987; took it after tenting, 6020; were thirsty, and glad to get it, 6020; thawed water for it in May, 6021; advantage over extended parties in taking it, as economy in fuel not so necessary, 6022-3; he took it as an antiscorbutic, and liked it also, 6068.

Dr. Barnes—

The double allowance given before sledging very judicious, 7119.

Alexander Gray—

Liked it, 7384; it was as good as the whalers, 7385; when and how served out, 7358-92; mixed at the tub, 7393; drunk before the officer, 7396; every one drunk it, 7401; spoils grog when mixed with it, 7399-7400; some would have drunk more if allowed it, 7396-7; would have liked it when sledging, 7465-6; difficulty of thawing it and enough water together in the cooking apparatus, 7480-81; objection to mixing it with tea or coffee, 7484-92; appearance and condition of at Polaris Bay,

LIME JUICE. 2. Recent Expedition, *continued*—
7525-37; was darker and more tart than the navy juice,
7533-5; mixed it up with molasses, 7536.

Thomas Rawlings—

Taken on northern sledge party as a medical comfort,
7666-8; did not miss it sledging, 7742; every one obliged
to take it on board, 7744; the extra allowance sent to the
messes and generally taken, 7746-9.

Color-Sergeant Wood—

Compulsorily taken by all, 7895-8, 7923, 7961; he watched
over its issue sometimes, 7961-2; never allowed evasion
of drinking it, 7967; some did not like it, but had to
take it, 7897, 7968-70; but most did, 7968; no difference
noticed as regards them in health, 7899; the ship's
steward always took it, 7963; Francombe allowed to
drink his allowance half at a time, 7964-6; did not
carry it the whole way sledging, 7903-4; did not get any
till they found some at a dépôt on return, 7906-9; how
served out, 7907; was glad to get it, 7909; would have
liked it sledging, 7984-5; would have wanted more fuel
to melt it, 7987; before arrival of relief party had been
having it for some days, 8026-7; did good as change of
food, 8028; advantage of treatment with it on board,
8053-65.

Mr. Emerson—

General liking for it, 8107; it was always drunk, 8107;
and looked forward to, 8362-3; did not carry any
sledging in autumn or spring, 8130, 8295; or get any
at Polaris Bay, 8131, 8308-9; the men of his sledge
had it when on board "Alert," 8144; were about twenty-
six days without it, 8145.

William Jenkins—

Took his full allowance regularly, 8386, 8436; liked it,
8387, 8432; had none sledging, but got some when on
board "Alert," 8388-91; every one took it on board, 8450,
8504-5; and liked it, 8492, 8504; arrangements for
serving it out, 8450; that at Polaris Bay rather stronger
than the navy juice, 8468-70; it would not cure scurvy
without change of diet, 8491; it was considered a pre-
ventive of scurvy, 8493, 8505; ordered by the medical
officer to drink it regularly, 8505; took a great deal
when ill, 8403-4; he had a craving for it, 8415.

Sir A. Armstrong—

In sledging would have assisted assimilation of food,
9008-9; prevented debility, 9093; and scurvy and other
affections, 9019-20, 9090; no advantage in the double
allowance given before starting, 9022; attached impor-
tance to it in his instructions, owing to previous expe-
rience, 9085-6; the medical officer of the "Alert" had
concluded his duty when he represented it should be
sent sledging, 9287-9; but he might have made a
written remonstrance, 9288; whether the remonstrance
was sufficient in the two ships, 9290-95; analysis of it,
its soundness, 9103.

3. Former Expeditions and Journeys—

Sir G. Nares—

Comparison of recent with former expeditions, showing if it
was taken sledging, 203; scurvy in Sir J. Ross's expedi-
tion in spite of it, 166.

Captain Hamilton—

None taken in Austin's and Belcher's sledge expeditions
(letter of G. Murray), 2996; case of a man who served
in three arctic expeditions and never drank it, 2996; a
bottle or two taken in 1851, it was eaten as water-ice
within four days, 2998; believes the bottles were quarts,
3000; all used in four days as the bottles had broken,
and it would have been lost, 2998, 3001-3; no difficulty
in getting men to drink it, but there were exceptions,
3012; was sent to depots, but not used, 3065; whether
a daily ration, 3078; objection to carrying fuel, or
mixing it with grog, or tea, 3032; it had been issued on
voyages according to instructions, 3079; has always
taken his own allowance, 3081.

Admiral Richards—

Lime juice not used because frozen, 3106-7; would have
been glad to drink it but could not thaw it, 3107;
believes he left in dépôt, on his first extended journey,
3107, 3226; thinks he carried it, 3139; did not take it
except in first extended journey, some recollection of
taking a small tin can then, 3225; would remember
thawing it, but does not do so, 3227; issued on board to
the messes, no compulsion used to make them drink it,
3128, 3135; never drank it himself, 3130; issued as a
ration, but not compulsory, 3200; not carried when crew
of "Resolute" marched to "Phoenix," 3199.

Sir L. McClintock—

Lime juice taken (an ounce a day) in Sir J. Ross's sledge
journeys, 3250-51; not in subsequent journeys, 3252,
3300, 3347; not considered necessary with pemmican
and unsalted meat, 3252-3, 3348; given regularly
in his expeditions, 3282; drunk below, and mixed
with grog, 3283; the men fond of it, 3284; is not
aware of its deterioration by cold, 3288; would spoil
the tea if put into it, 3303; in the "Fox," that supplied
by the Admiralty very good, 3359; some obtained from
whalers inferior, 3360; reduction of it when game was
obtained, and stoppage when sugar beer was issued,

LIME JUICE. 3. Former Expeditions and Journeys, *con-*
tinued—

3361; it was a principle to take it with salt meat, disuse
it with fresh, 3386; Sir J. Richardson took pemmican,
not lime juice, 3387; and had no scurvy, 3388.

Captain Hobson—

Did not carry it sledging, 3414, 3460; reasons for not
doing so, difficulty of thawing it, objection of men to
putting it in tea or grog, 3415; aggravation of thirst if
sucked frozen, 3415; it was always issued, but to the
messes only, 3432-4; did not drink it much, 3443-4;
drank very little in "Fox," the supply being short, 3444,
3531; was regularly consumed by the men, 3470,
3479; the full allowance always served out, 3471; did
not suspect its quality, 3472; to what extent freezing
destroys its properties, 3472-5; scarcity of, on board the
"Fox," 3469; thought he could stand anything, and
gave up allowance to others, 3531-33; likes it, 3534; it
would have mitigated his attack had he taken it, 3535;
it should be taken on long sledge journeys, 3539.

Dr. Toms—

It was taken on his only sledge journey, 3553; issue of it
in "North Star," 3554, 3679-80; it was given on board,
but men not made to drink it, 3602; could be trusted to
drink it, 3680; it did not deteriorate in arctic regions,
3603; from the temperature it was exposed to, 3689;
it is important to carry it sledging, 3627; is an essential
article of diet, 3751-3; objection to putting it into tea,
as it would make it unpalatable, 3631-2; it was carried
by sledges from "Pioneer" and "North Star," and
taken, 3686-88, 3707-09; fuel was allowed for melting if
asked for, 3755; opinion of Sherard Osborn about it,
3756; three-quarters of an ounce should be given daily,
one ounce to sledging parties, 3760; health in his expe-
ditions due to careful manner in which lime juice was
taken, 3760.

Captain A. Young—

Was not carried sledging, 3770; it was issued in the
"Fox," men not forced to drink it, 3800-1; reduction in
allowance, 3801; it was not issued with fresh provisions
or sugar beer, 3803; did not take it when on board after
third journey, 3847; that of "Fox" of the best quality,
3864.

Dr. Scott, "Intrepid"—

Lime juice given regularly, except when fresh meat was
issued, 3912; it was taken to their messes and drunk,
3913, 3918-19; the men were fond of it, 3913; did not
take it sledging, 3914; difficulty of taking it in its
present form, 3915; it should be taken sledging if it can
be carried, 4016, 4018; probability of his men having
been attacked with scurvy if it had not been taken on
board, 3920; it did not deteriorate, and would not,
with freezing, 3922-3; scurvy in late expedition broke
out soon after leaving it off, 3954-5; instances of long
sledging parties without it, and with no scurvy, 4030.

Mr. Ede, 1850-51—

Was taken regularly in "Assistance," 4047; taken by the
men at the tub, 4048; no one refused to drink it, 4049,
4081; was taken with satisfaction, 4082; not taken in
autumn sledging, 4066, 4143; was taken in spring, no
difficulty in carriage, 4070-71, 4083; quarter of an
ounce given, 4073, 4148; in the evening before the food,
4073-6; it was eaten when frozen, 4076-7, 4123; did
not thaw it, 4084, 4150; broke the neck of the bottle to
get it out, 4151; no difference in its ingredients in any
part of the bottle, 4152-3; it was a friable mass, 4154;
easily issued, 4156; was roughly measured, 4156; was
taken without dilution, 4159; no bad effects followed,
4161-4; it was good and efficacious, assuaged thirst, and
was much prized, 4079-80, 4165; it was taken in quart
bottles, 4086; about eight gallons the ration for nine
men for eighty days, 4085-9; is a powerful antiscorbutic,
4090; no deterioration in the arctic, 4093; it should be
carried sledging, 4121.

Dr. Lyall, 1852-54—

Served out regularly in the "Assistance," 4290; taken
from the tub, 4292; and carried below, 4300; no officer
specially saw it taken, 4291; believes all took it, 4293,
4299, 4301; no exception except among officers, 4302;
did not connect symptoms of scurvy with not drinking it,
4294; a quarter ounce the daily ration when sledg-
ing, 4295, 4352; does not recollect using it, 4297, 4305,
4353, 4371; nor taking it himself, 4297-8, 4354; not
taken the early part of the season, but left in dépôt,
4418; it should be taken sledging, but there is difficulty
in using it, 4296; no deterioration in the arctic, 4303;
would carry more vegetables sledging or more lime juice
than they did, 4307; men who have taken it up to the
time of sledging might ward off an attack of scurvy,
4417.

Dr. Piers, 1850-54—

When it was issued in "Investigator" the men were seen
to take it, 4511-12; the ration was one ounce, 4598-9;
is sure it was taken, 4600; reduction to half-an-ounce,
4482; in October, 1852, 4507, 4612, 4627-9; reduction
conducive to weakness of the crew, 4508; a liberal
allowance in "Resolute," 4484.

LIME JUICE. 3. Former Expeditions and Journeys, *continued*—

Dr. Buzzard—

Instance of disappearance of scurvy on board H.M.S. "Suffolk" on increase of lime juice, 5454.

Dr. Dickson—

Lime juice was regularly used in his voyage to the arctic, 5677; one ounce a-day a double ration, 5678.

Vice-Admiral Ommanney, "Assistance," 1851-52—

Hardly a ration, was taken sledging as a medical comfort, 5757; taken even on short journeys, 5767; cannot remember its being used, 5758, 5840; a conference held as to taking it, and it was asked for by men who had sledged in the autumn, 5758; extent it was carried in the different sledges, 5759, 5817; he took fourteen pounds, but cannot remember its being used, 5760, 5840-42; on board was issued to the messes, 5761-2; no compulsion of drinking necessary, being liked, 5762-3; no complaint of its not being drunk, 5764; the ration one ounce, 5798; has always issued it on board, 5899; advantage of it on board the "Vesuvius," 5900-1; a quarter of an ounce the allowance sledging, 5842, 5765-8, 5788; believes it was taken at luncheon, with grog, 5767, 5840; opinion of men in favour of it then, 5857; doubts its having been thawed in cold weather, 5767; heard no complaint of impossibility of thawing it, 5841; taking it was optional, 5786-7; none was returned from sledges, 5832-3.

Rear-Admiral Pullen—

None taken in boat journeys in 1849-51, 6096, 6162; not considering it necessary with preserved meat and vegetables, 6162; it is the custom at sea to give it after fourteen days' salt provisions, 6193; as an antiscorbutic, 6195; considers it should be taken, but does not remember issuing it in the arctic, 6200; the difficulties of thawing lime juice would prevent taking it, he never took it sledging, 6202, 6223, 6232; it was only occasionally issued in the "North Star," 6207-8; was drunk mixed at the tub, 6209.

Mr. Bayley, Boatswain, "North Star," 1849—

Was taken regularly in the messes, not under supervision, 6257-59, 6334, 6356-58; one ounce a-day, 6335-6; did not drink it often, 6341; his messmates drank it, most liking it, 6342-4.

"Assistance," 1852-54—

Half-a-pint with water the daily ration, 6273, 6354-5; was sent to messes, 6274, 6357; seldom took it himself, 6275, 6361; not liking it, 6296; no compulsion about taking it, 6297-8; nor supervision, 6354-62; his was drunk in the mess not by himself, 6361-2; did not carry it sledging, 6292, 6374.

J. Organ, "Assistance," 1852-54—

Always took it on board, 6572; being regularly served out to messes, 6573, 6683; about one ounce, 6684; did not take it sledging, 6584-7, 6632, 6674.

"Enterprise," 1848-49—

Issued every day, 6544, 6619; to the messes, 6545; took his ration himself, and believes every one did, 6546-8, 6620; supervised its being taken, 6621.

Mr. Murray, "Enterprise," 1850-55—

Drank it on board daily, 6876, 6914; how served out, 6877; not at the tub, 6878; thinks it was taken by all, 6879-80.

Sir A. Armstrong, "Investigator," 1850-54—

Was regularly taken on board, 8939, 9199; health of crew maintained by this, 9198-9; one ounce a-day given, 9200; bad effects of reduction in 1852, 9216; not sent sledging from "Investigator," the quantity being insufficient, 9005, 9203.

Dr. Robertson's letter at end of Evidence, page 316.

"Enterprise," 1848-49—

The lime juice supplied contained only one-tenth of its proper portion of acid.

4. Merchant Service—

Captain Allen Young—

Scurvy where men had it in merchant service, 3817; whether at times scurvy appeared it was impure, 3824; Board of Trade regulations, 3825; administration of it in the merchant navy enforced by Act of Parliament, 3865; penalty for neglecting Board of Trade regulations, 3866; it is issued, but men will not drink it unless in presence of an officer, 3867; how far this can be enforced, 3868.

Mr. Leach—

Regulations and arrangements for use, 5556-71; one ounce the daily ration in some ships, 5597.

Dr. Dickson—

Is a required ration in the merchant service, 5666; wording of the Act of Parliament enforcing its issue, 5667; importance of a daily issue, 5667; improvement in the merchant navy since the Act, 5668-9, 5670-71.

Alexander Gray, Ice-Quartermaster—

Use of it on board whalers, 7284-97; irregular measurement, 7287-90; about half-a-gill daily, with sugar and water, 7288-90; it was well liked generally, 7291-2; and never thrown away, 7296; especially with hard work, 7292; some parties did not care about it, 7294;

LIME JUICE. 4. Merchant Service, *continued*—

doubt whether the whalers which had scurvy took it, 7299-304; does not know whether ships without suffered more, 7612; only lately taken compulsorily, 7611; all his ships have taken it, 7616; took it to keep off scurvy; not so much as in late expedition, 7618; not more vegetables taken by ships unprovided with it, 7613-14.

Mr. Emmerson—

It was given every day fourteen days after leaving England till Calcutta, 8349-52; was not given in ships in Baltic trade, 8353-4; but fresh vegetables were carried, 8355; is taken readily as a pleasant beverage, 8359-61.

5. Carrying it Sledging, and Concentrating it—

Sir G. Nares—

What the weight would be for forty-two days' sledging, 185; shortening length of sledge journeys would enable it to be carried, 200; difficulties in carrying it owing to extra weight, and the fuel required to melt it, 170-79; and breakage of bottles, 186; difficulty of altering equipment of sledges, so as to carry it, 190; he would have sent it sledging, but for the fuel; it had been issued for sending out to western party before scurvy began, 9304; as far as weight goes, it can be carried, but the difficulty of carriage in its present state remains, 186, 9387.

Captain Stephenson—

Carried in glass bottles covered with wicker, 505; it could not be carried in its present form, 477; how far weights of sledges might be altered to carry it, 493-6.

Captain Markham—

How carried, 618-20; possibility of taking it if it could be carried as a lozenge, 736; difficulty in carrying it in small bottles, 753; owing to weight and breakage, 754; difficulty of carrying it and thawing it, 758; and sugar to mix with it, 763-4; possibility of carrying it in bladders and thawing it in sleeping bags, 759-761; fuel would be wanted to melt water for it, 762.

Lieutenant Rawson—

Suggestion of taking it in a condensed form, 1167.

Lieutenant Giffard—

Each day's allowance to be carried in a separate bottle, 1248.

Commander Aldrich—

Practicability of carrying it in a condensed form, 1301; difficulty of thawing it at night, it should be carried in something not easily broken, 1302.

Commander Parr—

How carried, 1481; the neck of one bottle broken, 1484.

Dr. Colan—

Possibility of extracting water and concentrating it, 1776-7; advantage as regards carriage, 1777; doubt about taking it in concentrated form, 2159-61; it might be carried in bags when frozen, 2093.

Dr. Moss—

Possibility of carrying it in a condensed form, 2351, 2428; whether practicable to remove water without deterioration of therapeutical effects, 2336-42, 2427; advantage of taking it so, 2352, 2426; it would require water for dilution and fuel, 2350; was carried in wicker jars, 2334; carried it in his last journey, 2424; inconvenience of weight, and liability to fracture of the jars, 2425; difficulty of taking it when frozen, 2455; if carried in capsules, might be thawed in tea, 2456; would carry one ounce a-day, 2484; does not see how, under the circumstances, a sufficient quantity could have been carried, 2485-8; pure lime juice in capsules injurious, 2497.

Dr. Nimis—

Difficulty of taking it sledging, owing to its weight and that of necessary fuel, 2659; to what extent this might be obviated by removal of water, 2660-63; possibility of condensing it, 2667, 2726; usefulness of doing so, 2707.

Dr. Coppinger—

Difficulty of men keeping it thawed by carrying it about their persons, 2962-3; possibility of condensing it by abstraction of water and addition of sugar, 2905; how far the antiscorbutic properties might be lost in the process, 2906; vegetable juices may be preserved as extracts without loss of property, 2907-8.

Captain Hamilton—

Advantage of carrying it in a condensed form, 3032; objection to carrying it sledging owing to its weight and freezing, 2996, 3083; the weights being strictly limited, and fuel wanted to thaw it, 3083; objection to half for thawing water, 3083.

Admiral Richards—

A good deal of it lost in his first winter through bottles breaking, 3132; has little recollection of it, 3132; possibility of carrying it in capsules and thawing it in the bags at night, difficulty in early sledging, 3140-42; as spirit froze next his skin in a bottle covered with flannel, 3142.

Sir L. McClintock—

If necessary it might be taken in small tin vessels, and dropped into tea when making to thaw, 3301; expenditure of fuel chiefly on water to be mixed with it, 3302.

LIME JUICE. 5. Carrying it Sledging, and Concentrating it, *continued*—

Captain Hobson—

Suggestion to take it in capsules to prevent necessity of thawing water, 3447-8; doubt whether the acid would destroy the case, 3449.

Dr. Toms—

Possibility of carrying it as a lozenge, 3628-9; advantage of doing so, 3633; an objection to carrying it is the additional weight, 3724; advantage of abstracting water, 3725.

Dr. Scott—

Difficulty in taking it in its present form, 3915; objections to taking it, its freezing, brittleness of its bottles, its weight, and fuel required, 4017.

Mr. Ede—

One bottle broke from frost, but it was carried all the same from "Assistance," 4072; about eight gallons the ration for nine men for eighty days, 4085-9; it should be carried sledging, 4121; want of fuel no insuperable difficulty, 4122.

Dr. Lyall—

It was carried from "Assistance" sledging in a tin case, 4304; there is a difficulty in using it in sledging, 4296; possibility of its being carried in capsules and mixing it with rations, 4309-11; thus obviating necessity of thawing water for it, 4310.

Dr. Macdonald—

By drying the extract it is soluble in water at freezing, 4935-6; can be reduced to one-tenth its bulk without altering the chemical composition, 4910; possibility of this, 4948; he has made lozenges by concentrating lime juice and mixing sugar with it, 4938-47; practicability of their being taken in the arctic, being easily carried, 4943; but responsibility of trusting to what has not been tried, 4943; the lozenges found to have retained the original constitution, 4944; change made in the sugar on mixing extract of lime juice with it, 4947-8; advantage of a conical bottle as not likely to break, 4937.

Dr. De Chaumont—

Practicability of carrying it in the form of a lozenge, 5106-10, 5114; doubt whether reduced lime juice would act as well as citric acid lozenges, 5114-15.

Dr. Pavy—

Evaporating it to dryness would destroy its chemical properties and its antiscorbutic value, 5223-4; unsafe to rely on such a preparation to keep off scurvy, 5226-7; if enough heat has been employed to coagulate its albuminous principle, 5227-8; possibility of evaporating it in vacuo, and making it easily portable, 5226-31, 5239-41; to what extent heat may be employed, 5239-42.

Mr. Busk—

It might have been taken in a concentrated form, or as citric acid, though these substitutes are doubtful, 5249, 5261; and but little hope of their success unless prepared in vacuo, 5261; their efficacy can only be determined by experiments on a large scale, 5262; objections to the weight of the fuel necessary for melting it, if carried in cold weather, 5260; want of success of Dr. Lind's "rob," 5249, 5261.

Dr. Guy—

Possibility of concentrating it, as shown by that frozen in Polaris Bay, 5394; advantage of carrying it in the form of a lozenge, if its essential parts are retained, 5396-9; many extracts obtained by evaporation in vacuo at low temperatures, without losing their properties, 5397; possibility of the properties of lime juice being preserved if so prepared, 5398.

Dr. Buzzard—

Possibility of concentrating it, 5515.

Dr. Dickson—

It might have been concentrated into a denser form, 5626, 5704; or mixed with rum, 5626, 5680; the mixture would be palatable, 5682; and would partly prevent freezing, 5683-4; doubt about concentrating it into a solid form without losing its properties, 5704; would be valuable in the form of a lozenge, if possible, 5705-6.

Dr. Barnes—

Possibility of concentrating it, but difficulty of experiment on men, 7131; danger of trying lozenges without experiments, 7142; a sailor too valuable to risk trying them on, 7142; chemical opinions not sufficient, 7143.

Color-Sergeant Wood—

How they could have carried it, 7986.

Dr. Muoro—

Possibility of carrying it even frozen, 8616; or in a condensed form, 8618-19; condensed preparations should not be trusted to till well tried, 8699.

Dr. Rae—

Suggestion to carry it in flat bottles, 8761.

Sir A. Armstrong—

No difficulties of carriage should prevent its being taken, 9178; or have prevented its being sent sledging in the late expedition, 9008; suggestion to mix it with rum, tea, or pemmican, 9008, 9016, 9093; it can be carried sledging and used in very low temperatures, 9091-2; sug-

LIME JUICE. 5. Carrying, Sledging, and Concentrating it, *continued*—

gestions for carrying it in wooden breakers or tins, 9093-4; objection to eating it in a frozen state, 9095; should be mixed with rum and tea, 9096; objection to trying lozenges, extracts, or any substitute on seamen without full previous trial, 9098, 9103-5, 9109, 9171, 9179-85; in spite of the trials being chemically satisfactory, 9100-3; and probably a desirable mode of carrying it, 9105; possibility of trying experiments, 9183-4.

LORIMER (or LORRIMER), WILLIAM, A.B., of "Alert"—

Dr. Colan—

Brought back ill of scurvy, after accompanying Lieutenant Giffard, 1895-9.

Lieutenant Giffard—

His case, 1220; lime juice taken when illness occurred, 1222.

LOWER DECK. [See *Ventilation*.]

MALIC ACID. [See *Acid*.]

MARINES, ROYAL. [See *Selection of Men, Discipline*.]

MEAT. [See also *Diet*.]

Subheads 1. General.

2. Recent Expedition.

3. Former Expeditions.

4. Musk Ox.

Papers with Report.

Reports on Salt Beef, Salt Pork, Ox-cheek, and Collops of recent expedition.

Evidence.

1. General—

Sir G. Nares—

Salt meat should never be used on arctic service, 34; but preserved meat continuously used is insipid, 34-35; salt meat more pleasing, 35; preserved meat inferior to fresh and to pemmican, 43; in no expedition have crew eaten $1\frac{1}{4}$ lb. of meat daily, 42; advantage of fresh meat in scurvy, 44.

Lieutenant Rawson—

Preserved meat not a sufficient antiscorbutic, 1119.

Commander Aldrich—

Suggestion to take some preserved meat sledging, as a change on pemmican, 1303.

Dr. Colan—

Advantage of and preference for hot meat, 2099-2101.

Dr. Coppinger—

Superiority of seal meat to musk-ox flesh, 2920-21; it is preferred by the Esquimaux, 2921.

Captain Hamilton—

Reasons for preference for salt over preserved meat, 3075; preserved meat more freely used in recent expedition than formerly, disadvantage of this, 3041.

Captain Hobson—

Game should not be relied on, 3496.

Dr. Lyall—

Preserved meat rather insipid, 4411.

Mr. Piers—

Salt meat conducive to scurvy, and should be avoided, 4555-6.

Dr. Macdonald—

Instance of benefit of salt meat with scorbutic symptoms, 4851; immunity of Captain Tyson's party perhaps due to seal meat, 4925-6.

Dr. De Chaumont—

Fresh meat antiscorbutic, 5130-32.

Dr. Pavy—

Value of seal meat and other fresh meat in curing scurvy, 5153; raw meat more efficacious than cooked, 5155-6; chemical composition of it being changed, 5157-8; fresh meat induces a better state of nourishment, and ranks next to fresh vegetables in antiscorbutic properties, 5170; greater liability to scurvy under salt meat, 5218; it being deficient in fresh juice, 5219; preserved meat retains the elements of its nutritive properties, and is not injurious, but is not so good for maintaining health, 5220-21.

Mr. Busk—

Raw meat has antiscorbutic properties, 5271-5.

Dr. Buzzard—

Preserved meat not so nutritious as fresh, 5471; desire of the men in the Crimea for fresh meat, 5471; cooked inferior to raw in antiscorbutic property, 5510; the salted is not an active agent in production of scurvy, but is less nutritious than fresh, 5491-4.

Dr. Dickson—

Pork much relished by seamen, and very nutritious, it should be issued with preserved meat, 5662; fresh meat is antiscorbutic, it maintains the standard of health, 5695-6; immunity of "Polaris" party perhaps due to seal meat, 5702-3.

Dr. Barnes—

Raw meat most antiscorbutic, as cooking coagulates the albumen, 7122-3; immunity of "Polaris" party perhaps due to it, 7122-5; doubts whether any people live for long on raw meat, 7126; but it might be an equivalent for fresh vegetables, 7148.

MEAT. 1. General, *continued*—

William Jenkins—

Salt meat considered bad for scurvy, 8382, 8461.

Dr. Rac—

A large quantity necessary in absence of vegetables, 8784.

Sir A. Armstrong—

Salt meat not so nutritious as fresh, and hence predisposes to scurvy, 8957-9; animal food, raw or partly cooked, may keep off scurvy, 9002-3, 9167-8; a large amount of lactic and phosphoric acid in raw meat, 9003; more food, especially fatty food, required in a cold climate, 9148-9.

2. Recent Expedition—

Sir G. Nares—

Recommendations of Medical Director-General as to issue of, not acted on, 28; stock of meat not enough to give two pounds for three years, 29-30; inability of men to eat more than one and a quarter pound a-day, 29, 9303; stock of meat ample without game, 30; proportion of salt and preserved, and amount of meat, 31; increase of ration of preserved meat and salt pork by a quarter of a pound, 32; increase of ration of salt beef discontinued, 32-33; a saving on both kinds of meat in winter, 33; the salt meat when kept in snow-houses became less salt, and was liked by the officers, 9303; though the crew were prejudiced against it, 9303; very little was given away, some left behind, 9313; some thrown overboard in warm weather, and so expended, 9313-14; expected game to be found by the western and Greenland parties, not by the northern, 9348.

Captain Stephenson—

Fresh meat on board the "Discovery" 800 lbs. a-month, 291; men could not have consumed more than their ration of meat, 302-3; no savings except biscuit, 304, 312; issue of looms, 305-6; a few sheep supplied; mutton preserved frozen, 308, 310.

Captain Markham—

Allowance not consumed, 539; preserved meat very good, but fresh meat preferable, 658; preserved beef and mutton both supplied, no preference for either, 659; greater amount of fresh meat in "Discovery," 769.

Commander Bearmont—

Advantage of fresh meat as regards health of "Discovery's" crew over "Alert," 1013-14.

Lieutenant Rawson—

Did not get any game till arrival at Polaris Bay, 1111; sufficient meat issued to men, 1120; their inability to eat the full allowance, officers able to eat theirs, 1120.

Commander Aldrich—

Whole allowance of preserved meat (found in dépôt) eaten by sick men, 1303; one pound used sledging instead of pemmican and bacon in autumn, 1316-7; none in spring except at the dépôt, 1331.

Dr. Colan—

The victualling in "Alert" satisfactory according to arctic scales, 1671; increase of meat in October, at his representation, 1673, 2123; the amount given sufficient, 2124; the food satisfactory, except the beef, which was salt, 1674, 1677; small amount of fresh meat given (fourteen dinners in ten months), 2075; more given to sick men, 2076; amount given, 2185; sufficient fatty matter in the meat, 2097; no wish for more, 2098; absence of fresh meat predisposed men to sickness, 2000; comparative immunity of "Discovery" from scurvy due to larger supply of fresh meat, 2110.

Dr. Moss—

Beef in "Alert" more salt than usual, though the quality was better, 2298.

Dr. Ninnis—

A great deal of fresh meat obtained in "Discovery," 2556-8; mutton at Christmas, 2558; omission of fresh meat sledging cause of scurvy, 2595; sufficient would have prevented it except for the severe labour, 2595-8; comparative immunity in "Discovery" over "Alert" due to fresh meat, 2668-76.

Dr. Coppinger—

Seal meat given to the sick, 2919; superior to musk-ox flesh, 2920; Lieutenant Beaumont's crew improved when supplied with fresh meat, 2974; salt beef in "Discovery" tough and hard, 2982; inferior to ordinary beef, 2983; was satisfied with the other food, 2984.

Dr. Lyall—

He superintended corning of the beef supplied to the recent expedition, 4405; was satisfied with it, 4406; the same was used in former expeditions, of the best quality and salted in the ordinary way, 4407.

Dr. Dickson—

Comparative immunity of the "Discovery" due to fresh meat, 5695-6.

Captain Feilden—

Heard the salt meat was tough, 6024; he liked it very well, 6077.

Alexander Gray—

Salt meat of "Discovery" was considered rather salt, 7204-5; salt meat once a-week, personally did not eat it, but some liked it, 7346-7, 7350, 7596; always had meat for dinner, 7348-9; what food was given, 7344; saved

MEAT. 2. Recent Expedition, *continued*—

meat or ate the whole allowance according to appetite, 7351-4; liked the preserved meat, pork and hotch-potch, 7598-7600; no extra food given after the watch, 7382.

Thomas Rawlings—

Salt beef not so good as usual, 7628, 7669-71; pork and other provisions very good, 7628-9, 7672-3, 7690-91.

Color-Sergeant Wood—

Salt beef too salt to eat, 7888, 7950; not taken up, 7929; could not make it suitable, 7950; did not like the minced collops and ox-cheek, 7890-1; the collops and beef generally disliked, 7893, 7924; though good, 7945; collops too rich to eat much of, 7949; no complaint was made to the captain, 7894.

Mr. Emmerson—

Salt beef and pork bad, 8100-1; could not eat it, 8104, 8329; salt meat stopped owing to objection to it, 8104, 8209, 8212; preserved meat was issued in lieu of it, 8213; used to make preserved meat last two days rather than take the salt meat up, 8104, 8209; which amounted to half-rations one day a-week, 8210-11; never had such bad salt provisions, 8104, 8202-3; they were hard and salt, 8189-90; why not complained of before "Valorous" left, 8191-2; the beef was not taken up or eaten, and therefore could do no harm, 8194-8; the ox-cheek was good, 8226-8; the minced collops were not liked, 8168, 8225; the half-rations issued with other preserved meat were not eaten, 8229-34; collops had no substance in them 8169-71; pork nice but fishy, 8199, 8201, 8217, 8330; it was issued once a-week throughout the winter, 8214-15; about half the men took it up, the rest left most, 8214, 8217-24, 8331; objecting to it as fishy, 8332-3; the meat taken up and cooked was divided among all the messes and sometimes eaten cold, 8224; amount of game exclusive of musk ox, 8269-77, 8284-6; fresh mutton on Christmas day, 8283; does not care for preserved meat, but lived on it and fresh meat, 8337-40; seldom touching the salt meat, 8340.

William Jenkins—

The pork good, better than any he had had before, 8383-5; not fishy, 8425, 8503; the collops were disliked, 8426-7; being like sawdust, 8427; the other preserved meats very good, 8429; liked the seal meat at Polaris Bay, 8476; it was bad to look at, 8477; how obtained, 8481; what game was got, 8481-4; did not eat the salt meat, 8381, 8461; beautiful meat, but too salt, 8382, 8424, 8463, 8501; ate a great deal of seal meat and game, 8401-2; had a craving for it, 8414.

Mr. Thomas Mitchell—

Salt meat in "Discovery" all taken up and eaten by his messmates, 8896-8903; beef was complained of as hard and salt, 8897; and not so palatable as ordinary navy beef, 8912-13; salt pork not fishy, 8914-15; the collops were not popular, 8907-8; ox-cheek was very nice, 8909.

Sir A. Armstrong—

Suggestion to Arctic Committee that other means of preserving meat, besides salting, should be found, 8961; more meat should have been given, 8956, 9061; the diet should have been larger and more in accordance with his recommendations, 8955; the meat preserved with less salt, 8961; objections he made to the proposed scale, 9243; supply of meat increased in consequence, 9244.

3. Former Expeditions—

Sir G. Nares—

"Investigator" had not so much fresh meat as the "Resolute," 142.

Captain Hamilton—

Little meat obtained by "Assistance," 3019, 3077; 28,000 lbs. by "Resolute," 3019; both "Alert" and "Discovery" had more fresh meat than many ships, 3045-7.

Admiral Richards—

No fresh game got in "Assistance" during their two winters, 3123; except 80 looms brought by "Phoenix," 3124, 3153.

Sir L. M'Clintock—

Advantage of fresh meat (sea birds) in restoring health of "Enterprise," 3391; good deal of game when sledging, 3306, 3393; good deal of game in Sir J. Ross's sledging expedition, 3306; advantage of fresh meat in his sledging journey to Melville Island, 3392; the amount they got, 3393; it was eaten cooked, 3394.

Captain Hobson—

Much fresh meat obtained when in "Rattlesnake" and "Plover," 3418, 3452, 3518; could shoot any amount of meat, 3522-3; seals obtained in spring and autumn in "Fox," 3430; what fresh meat he got sledging from "Fox," 3430; men stricken with scurvy recovered with fresh meat, 3495.

Dr. Toms—

Got but little game in "North Star," 3635-6, 3690; no fresh meat or fish in "Pioneer," 3712; craving for fat bacon, 3739-40; preserved meats liked, 3741.

Captain A. Young—

Got no game, except one bear in third journey from the "Fox," 3769.

MEAT. 3. Former Expeditions, *continued*—

Mr. Ede—

What game they found in sledging from "Assistance," 4108.

Dr. Scott—

Large amount of fresh meat in "Discovery," compared with "Alert," 4013-14; amount obtained by "Resolute" and "Intrepid," 3917; 13,000 lbs., 4011.

Dr. Lyall—

Found no game in "Assistance," 4317; "Resolute" and "Investigator" had fresh meat, 4368; the "Assistance" hardly any, 4368.

Dr. Piers—

One and a-half pound should be given, 4453-5; a considerable quantity of fresh meat obtained in "Investigator" the second winter, 4459, 4607-8; some the third, 4539; chiefly reindeer, hares, and ptarmigan, 4540; not so much game got in 1852-3, 4637-41; in the spring of 1851-2 fresh meat about once in ten days, 4609.

Vice-Admiral Ommanney—

Less benefit in "Assistance" from game than any expedition, 5799; only one or two birds and foxes caught, 5800-2.

Mr. Bayley, "North Star," 1848-49—

Bad preserved meats, 6314-18, 6329; what the other meat was, 6330; got but little game, 6363-5, 6439.

"Assistance," 1852-54—

No game obtained, 6366-7; salt meat expressly provided, 6482; and was liked as much as preserved meat, 6483.

Sledging—

One deer shot, 6378.

J. Organ—

What game they had, less in "Resolute" than "Enterprise," 6789-94; got some sledging, 6709; the salt meat considered by the men to produce scurvy, 6812-13; some game got sledging with Admiral Osborn, 6709.

Mr. Murray—

Got a little game, 6872, 6874, 8670.

"Investigator," 1848-49—

Preserved meat bad, contractor was fined, 6838.

"Enterprise," 1850-55—

Provisions very good except some preserved meat, 6838; very little game the first winter, 6872-4; it all went to the sick, 6870; more the second winter, 6881, 6996.

Dr. Rae—

Lived on reindeer in 1845-46 in the winter, 8722; and seal meat, some game got, 8722; in 1850 shot some game, 8735; lived chiefly on deer, 8744.

Sir A. Armstrong—

Maintenance of health in sledge parties by fresh meat, 9204; amount of fresh meat obtained in "Investigator," 9209-10; was only a substitute for other meat, 9214; more fresh meat in "Resolute," 9240-41.

4. Musk ox.

Sir G. Nares—

"Discovery" had a supply of fresh musk ox, 95.

Captain Stephenson—

Musk ox beef strong flavored and not eaten by all men, 313-14.

Commander Markham—

Was approved of as fresh meat, 773; to what extent too musky, 774-8; impossible to kill so as to avoid flavor, 778; proportion of cows to bulls, 777.

Captain Beaumont—

To what extent it is palatable, 1011; how far men eat it, 1012.

Dr. Ninnis—

A great deal of musk ox obtained, 2556-8.

Dr. Coppinger—

Seamen disliked the flavor of musk, 2922; seal meat given to the sick and preferable to musk ox, 2919-21.

Vice-Admiral Ommanney—

None killed in "Assistance," 5781.

Mr. Emmerson—

Musk-ox days looked forward to, 8341; every part eaten, 8342; the liver and kidneys sweet, 8343; a good deal of musk ox obtained, 8105, 8281-2; issued twice a-week, 8277-8; the old oxen tasted too strong and tough to be liked, 8106, 8287, 8345-6; the young nice but lean, 8287.

MEDICAL EXAMINATION. [*Examination on Entry, see Selection of Men.*]*Papers in Appendix.*

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Evidence.

Sir G. Nares—

How examination for entry was conducted, 11-17, 9303; a monthly medical examination of crews held, 125; in the four early cases of scurvy, men had been reported healthy, 157; men not weighed on starting and returning from sledging, 211,

MEDICAL EXAMINATION, *continued*—

Captain Stephenson—

Medical examinations on entry held, 269-70; monthly medical examination of crew held, or oftener if necessary, 389.

Commander Beaumont—

Were held in the winter, 1179; had reference to health and cleanliness, 1180; men selected for sledging medically examined before starting, 1187.

Dr. Colan—

Examination of crew before extended sledging parties, 1729-41; to what extent his recommendations were or were not adopted as to doubtful men, 1733-42; men for minor sledge parties examined and found healthy, 1742; medical examination held the 1st of each month, 1813, 2034.

Dr. Moss—

Assisted in examining sledge crews, 2202-3.

Dr. Ninnis—

Inspected men constantly, 2534; was present at their entry examination, but not on the board, 2688.

Captain Hamilton—

"Assistance" and "Resolute"—

Crew of "Assistance" carefully examined before entry; not so in "Resolute," 3020, 3076.

Sir A. Armstrong—

All the crew of "Investigator" examined before starting by himself or his assistants, 8932-3; monthly medical examinations held on board the "Investigator," 8939; men of late expedition proved by examination to have been healthy, vigorous, and fit for their work after the winter, 8979, 8982-3, 9124; but perhaps might have diminished in vigor, 9124.

MEDICAL INSTRUCTIONS and Memorandum by Medical Director-General. [*Medical Director-General, Paper of Suggestions by. See also Discipline.*]*Papers in Appendix.*

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Evidence.

Sir G. Nares—

Was supplied with suggestions by Medical Director-General for health of expedition, 6; considered them recommendations, but not compulsory, 60; recommendations of Medical Director-General acted on, except as to issue of meat, 28; medical appliances and instructions sent with sledges, 240-244; instructions how to deal with frost-bites given, 245-6; medical handbooks supplied to the ships, 248; Naval Hygiene, book on, transferred to medical officer, 249; was frequently consulted by Dr. Colan about sledge instructions; his own confidence in immunity from scurvy and absence of mention in previous instructions may have led to omission of scurvy in them, 9303; Dr. Colan submitted his instructions for approval and suggestions, 9368; no symptoms alluded to were considered to have reference to scurvy, 9369; Sir Alexander Armstrong's "Naval Hygiene" mislaid, 9303; and not seen, 9329; no mention of sledging in it, but was affected by it, not having read it, 9383.

Captain Stephenson—

Received suggestions from Medical Director-General as to health, 261; recommendations of Medical Director-General were only suggestions, and were carried out as far as practicable, 458-9; recommendations of Medical Director-General as to issue of lime juice carried out on board, 362; and as far as practicable, 458-9; medical instructions given to officers commanding sledges, 448; no instructions as to scurvy, except recommendation of rest and change of diet, 449-50; officers had been shown the case of Shepherd, to acquaint them with symptoms of scurvy, 449.

Captain Markham—

Supplied with medical instructions when sledging, 600; scurvy not mentioned in them, 600, 734; no instructions given in winter, 733.

Lieutenant May—

Medical instructions did not touch on scurvy, 810.

Commander Beaumont—

What instruction was given in use of surgical appliances and medicines, 1188-90; measures against snow-blindness enjoined on sledge parties, but no cases occurred, 1192; every one instructed how to deal with frost-bites, no cases occurred, 1194; had no sledging instructions from medical officer as to scurvy, 926-8.

Lieutenant Rawson—

No medical instructions as to scurvy when sledging, 1106, 1163; but directions to eat scurvy-grass, 1154-5.

Lieutenant Giffard—

Had medical instructions and medicines, 1213; instructions furnished by surgeon of the ship, 1216.

Commander Aldrich, Commander Parr, and Lieutenant Egerton—

Had no medical instructions when sledging as to scurvy, 1351, 1479, 1561-2.

MEDICAL INSTRUCTIONS, &c., *continued*—

Dr. Colan—

Furnished instructions to officers, 1616, 2128-9; instructions framed by himself, 2052; what means he took for making them out, 2052, 2135; petty officers taught the use of medicines and appliances, 2052, 2135; no mention of scurvy in them, 2053, 2131; reasons for this, the instructions given them only contemplated slight ordinary cases, 2054, 2132; he acted up to his instructions from the Medical Director-General in issuing them, 2134, 2175; was aware of Medical Director-General's memorandum, 2174; submitted them to Captain Nares, 2136; who made no correction, 2137-8; told Captain Markham, in case of scurvy, to give onion powder and potato, 2139; and described certain symptoms, 2140.

Dr. Ninnis—

Did not give instructions to sledging officers as regards scurvy, 2719-20; instructions given only contemplated ordinary maladies, 2721.

Captain Hamilton, 1852-54—

Medical instructions when sledging contained no mention of scurvy, 3033.

Admiral Richards—

When sledging from "Resolute" his medical instructions contained no mention of scurvy, 3133-4.

Sir L. M'Clintock, in his journeys—

Medical instructions sledging did not embrace scurvy, 3289.

Dr. Toms—

The medical instructions he gave in "Pioneer" and "Intrepid" sledging expeditions referred to scurvy, 3606-7.

Dr. Scott—

The medical instructions he gave in Sir L. M'Clintock's sledging expeditions contained directions as to scurvy, 3925-6.

Mr. Busk—

Lessons by the medical officers in symptoms of scurvy should be given in the winter, 5249.

Captain Feilden—

The officer in command of sledges had some, but no mention of scurvy, 5956.

Sir A. Armstrong—

He supplied medical handbook for guidance of sledging officers, 9083; supplementing information as to scurvy by supplying his book on naval hygiene, in order that officers might acquaint themselves with early symptoms of scurvy, 9084, 9278.

Medical Instructions given to Sledging Officers—

Some verbal instructions as regards scurvy must have been given, 9042; references to scurvy-grass and sorrel point to scurvy, 9042; instructions should have been given, 9043, 9279-80; would have enabled the sledging officers to detect the disease, 9048, 9300; desirability of this if scurvy was apprehended, 9053; but they could not have treated scurvy not having the means, 9049, 9280; possibly on that account the doctors omitted to refer to it, 9052; assumption that scurvy had been talked of and its symptoms known, 9054; the captain should have suggested insertion of instructions as to scurvy, 9298-9; instructions should have been given by the captain to the sledging officers what to do in case of scurvy breaking out, 9043, 9050, 9279-80.

MEDICINES AND MEDICAL APPLIANCES.

Return of medicines, medical comforts, and medical utensils, supplied to "Alert" and "Discovery" . . . with Report.

Evidence.

Sir G. Nares—

Medical appliances and instructions sent with each sledge, 240-44; goggles supplied to prevent snow-blindness, 250.

Captain Stephenson—

Medical stores arranged by surgeons of each ship, 446.

Commander Beaumont—

What medical comforts he took sledging, 940; what instructions in use of surgical appliances and medicines was given, 1188-90; neutral-tinted glasses worn to prevent snow-blindness, 1191; a tourniquet carried, 1194.

Lieutenant Rawson—

Took no medical comforts, but had medicines, 1113; the medical instructions were written and came from surgeon of ship, 1163.

Lieutenant Giffard—

Had medicines when sledging, 1213.

Commander Aldrich—

No medical comforts taken, 1294.

Commander Parr—

Advantage of a doctor having accompanied them, 1450; medicines taken, but no medical comforts, 1448.

Dr. Colan—

Sledge party provided with medical appliances and instructions, 2052.

Dr. Ninnis—

Medicines for sledging should be sent in form of capsules, 2738.

Sir A. Armstrong—

Insufficient medical appliances sent sledging, 9079-81.

MEN, SELECTION OF.

Subheads 1. General.

2. Standard of age, height, &c.

Paper in Appendix.

Ages in former expeditions compared with recent

No.

one 34

Evidence.

1. General.

Sir G. Nares—

None of the crew in "Alert" had been employed in arctic service except six harpooners, 18; standard for selection fixed by himself; it agreed with recommendations of Medical Director-General; only two men below it, 7; in what respects, 10; not so useful, 9; suffered from scurvy, 9, 12; reasons for their selection, 10, 21, 22, 26, 27; was on his responsibility, 24; they were not employed on long sledge journeys, 12, 13; adheres to standard fixed; neither light nor heavy men fit for sledge travelling, 15; entry entirely in his hands, medical officers only reporting to him, 25; correction of previous statement, 9303; personally examined every man entered, 9303.

Captain Stephenson—

Entered most of the men for both ships, in absence of Captain Nares, 262-5; was perfectly satisfied with crew in all respects, 266-8.

Commander Beaumont—

Preference for men experienced in arctic travelling, if sound, 959.

Lieutenant Rawson—

No advantage in men who have taken previous voyages, 1123; but experience advantageous, 1125.

Dr. Moss—

Preference for blue jackets over marines for arctic sledge work, 2394-5.

Dr. Ninnis—

Majority of men of "Discovery" of fair complexion, 2692; was present at entry of men, but not on the Board, 2688.

Captain Hamilton, Expeditions in 1850-51, 1852-54—

Some of the men who stood the cold best just returned from Africa, 3016; average age of men older than recent expedition, 3017-18; Austin's crew healthier than Kellett's, though with less fresh meat, 3047-8; due to better selection of men, 3076; careful entry of crew of "Assistance," 3020.

Admiral Richards—

The advantage of having some experienced travellers in a sledge crew, 3235.

Sir L. M'Clintock—

Selection of men of the "Fox," no examination, most of them had previous arctic service, and were men-of-war's men of good character, 3400-1.

Captain Allen Young—

No opinion of height, weight and antecedent experience, 3862; the black man in "Fox" did his duty well, complained once of the cold, 3863.

Dr. Piers—

Young men best fitted for arctic service, 4532.

Commander Cameron—

In his journey across Africa his men were freed slaves from Zanzibar, all very dark, 4719-20; but little variation in colour, 4758; he had fifty-six men, 4755; no whites, 4757; no half-castes of recent origin, 4757.

Dr. Macdonald—

Fair men or sandy Scotchmen best suited to the arctics, 4843.

Rear-Admiral Pullen—

The Hudson's Bay men were half-breeds, 6146; the officers Scotch, 6146.

Thomas Rawlings—

Could not wish for a better crew than "Alert's," 7661.

Color-Sergeant Wood—

Marines and blue jackets equally good for sledge work, 8069-71.

Mr. Emmerson, Boatswain—

Could not have got a better class of men than in recent expedition, 8182-3.

Dr. Rae—

Nationalities of the men in his expeditions, 8726; and of men in 1850 journey, 8739; they were good boatmen and fit for any work, 8737-8; nature of the work done by the men living on the large meat diet, pretty hard work but not severe, 8830.

Sir A. Armstrong—

His views as to selection of men stated to Arctic Committee, 8934; does not object to the ages of the men in the late expedition, 9301; the best men for arctic service are men-of-war's men from twenty to thirty, 9301; entry of men of "Investigator," 8932-3.

2. Standard of Age and Height—

Sir G. Nares—

Age between twenty-five and thirty-two, to ensure taking only men of good conduct; height 5ft. 8in. to 5ft. 5in., 8; two below standard, 7; correction of previous statement, standard of age from twenty-five to thirty-one, and

MEN, SELECTION OF. 2. Standard of Age and Height, continued—

height from 5ft. 6in. to 5ft. 9in., 9303; personally examined every man entered, 9303.

Captain Stephenson—

Difficulty in obtaining a cooper, a man entered above age, 352.

Captain Hamilton—

Average age of men in his expeditions, 3017; older than recent expedition, 3018; recent expedition, men too young, 2996.

Admiral Richards—

The ages of men in his expedition, 3145; the men in the recent one rather young, 3145; the best age is thirty, 3146; limit of recent expedition, of twenty to thirty, rather low, 3147; it was adopted in consequence of the recommendation of the Medical Director-General, 3149; extract from this recommendation as to selection of men, 3150.

Sir L. M'Clintock—

Seamen between twenty-five and twenty-six less liable to scurvy than men over thirty, 3310.

Captain Hobson—

Best age between twenty-five and thirty-five, 3438.

Dr. Toms—

Men between thirty and forty less liable to scurvy than younger men, 3613; they have more determination and system is stronger, 3614; and have less anxiety, 3617; limit should be between thirty-one and forty-eight, 3618; formed his opinion upon conditions of crews taken home in "Phoenix," 3619-21; the ages of men of the "North Star" and "Pioneer," 3726.

Captain Allen Young—

Prefers men from thirty to thirty-five, 3809.

Dr. Scott—

Limit of age should be from twenty-five to forty, 3930.

Mr. Ede—

From twenty-five to thirty the best age for men, 4106-7.

Dr. Lyall—

The best age from twenty-four to thirty-four, 4316, 4402-3; to what extent men of the late expedition were younger, 4404.

Dr. Piers—

From twenty-one to thirty the best age for a first voyage, 4533; but some up to thirty-five might be taken, 4534.

Dr. Macdonald—

From twenty to thirty the best age, about five feet six or seven inches the best height, 4843.

Dr. De Chaumont—

Best age from twenty-five to thirty for arctic service, 5129.

Mr. Busk—

Best age for exertion between twenty-five and thirty-five, 5289.

Dr. Guy—

Best age, twenty-seven upwards, 5400-1; the constitution being more formed, 5402.

Dr. Dickson—

The age for arctic service should be from twenty-five to thirty-five, 5635, 5699; the young and old men more susceptible to scurvy than the middle aged, 5700-1.

Vice-Admiral Ommanney, 1850-51—

Average age was twenty-eight or thirty, 5777, 5884; standard should be from twenty-five to thirty, average height five feet ten inches, 5885.

Captain Feilden, R.A.—

Men of twenty-seven or twenty-eight better than of forty, 5967; the ages of the men employed were a proper standard, 5971; officers may be older, experience being necessary, 5969.

Mr. Bayley—

Best age from twenty to thirty, 6309-10.

Mr. Murray—

The proper age for arctic service is not over thirty or thirty-five, 6899, 6927; the youngest in "Enterprise," 1850-55, twenty-two, 6928; his own age whilst serving, 6898, 6910.

Dr. Barnes—

Would not select men under twenty-seven or twenty-eight, 7134; the constitution being then more formed, 7135.

Color-Sergeant Wood—

Majority of crew of "Alert" under thirty, 7927; and a very good age for the work, 7928.

Wm. Jenkins—

Ages of the crew of "Discovery," 8421-3.

Sir A. Armstrong—

Best men those from twenty to thirty, 9301.

MERCHANT SERVICE—

Alexander Gray, Ice-quartermaster—

No doctor winters in whalers which remain to catch whales, the hands being too few to require it, 7184-92.

MILK.

Proposed addition to arctic dietary of condensed milk, Captain Markham, 655; Dr. Colan, 2102; Lieutenant Rawson, 1171; Dr. Moss, 2432; Dr. Ninnis, 2710; Dr. Coppinger, 2930; Mr. Ede, 4253; Dr. Buzzard, 5473-4; Dr. Dickson, 5718.

Dr. Coppinger—

Should be taken as a medical comfort, 2933.

MILK, continued—

Dr. Toms—

Decicated milk taken and much appreciated in his expedition, 3665-8, 3744; it may contain nutritive properties of fresh milk, 3667-9; difficulty of taking it sledging from want of fuel, 3669.

Mr. Ede—

Condensed milk highly desirable, 4190-91; must be antiscorbutic, containing all the elements of life in proper proportions, 4192-4.

Dr. Lyall—

Supplied as a medical comfort in the late expedition, 4390-5.

Sir L. M'Clintock—

Condensed milk taken in his expedition as an experiment, 3402.

Commander Cameron—

Milk; to what extent obtained in Africa, 4768, 4799.

Dr. Pavy—

Milk an important element in dietaries, containing all the elements required by the body, 5194-5.

Mr. Busk—

Efficacious as an antiscorbutic, a considerable amount of belief in it justified, 5249.

Dr. Guy—

Advantage of milk in convict diet as compared with that in the late expedition, 5323.

Dr. Buzzard—

Condensed and desiccated milk very valuable, 5474-5; great antiscorbutic property of milk, children brought up on it, 5477; instance of existence for eight months on boiled milk without scurvy, 5477.

Dr. Dickson—

Preserved milk has not antiscorbutic property, 5717.

Vice-Admiral Ommanney—

Preserved milk a medical comfort in "Assistance," but liberally used, 5854; Moore's milk taken sledging, 5835-6; it was excellent, 5835; no difficulty in using it, 5838; description of it, 5853.

Dr. Barnes—

Excellent antiscorbutic effects, 7077; children thrive on it, 7082.

Dr. Rae—

Took condensed milk sledging, 8747.

Mr. Mitchell—

Condensed milk was used in the recent expedition by the officers, 8922-3; not issued as a ration, 8924.

Sir A. Armstrong—

Is antiscorbutic, 9192.

MOLASSES. [See Diet.]

MONTEIRO, MAJOR—

Commander Cameron—

Mention of scurvy among natives of Africa in 1836-37, 4743-4, 4802.

MURRAY—

Captain Hamilton—

Murray, G., petty officer of a sledge of "Resolute" in 1853, letter expressing his views, 2996.

MUSK OX. [See Meat.]

MUSTARD AND CRESS—

Sir G. Nares—

Mustard and cress grown and issued, but not as a general ration, 46, 48.

Dr. Colau—

Mustard and cress grown, doubtful efficacy as an antiscorbutic, 2150.

Dr. Moss—

Mustard and cress grown in small quantities, 2458; how reared, difficulties in raising it, 2459-60; good as an antiscorbutic, 2461.

Dr. Ninnis—

Large supplies of mustard and cress and other vegetables grown in warm weather, 2738; frames for growing should be taken, 2738.

Admiral Richards, 1852-54—

Grew a little mustard and cress; difficulty in growing it, 3154-6.

Sir L. M'Clintock—

A little mustard and cress raised in his ship, 3307-8.

Dr. Toms—

Had some in "North Star" about once a week, 3623-4.

Mr. Ede—

Found some and sorrel at the Carey Islands, 4109; grew a little in "Assistance," 4110; found it beneficial, 4112; preference for, over Edwards's potato, 4125; Americans ate it raw as a salad, and found it beneficial, 4125.

Dr. Lyall—

Grew some in "Assistance," 4319.

Dr. Piers—

In "Investigator," not much grown, 4542.

Mr. Bayley—

Grew some in "North Star," 6300-1.

Vice-Admiral Ommanney—

A little grown in "Assistance," 5758.

Captain Feilden—

Much might be produced on land in July with glass frames 5974; it was grown on board "Alert" in flannel and in boxes, 6070; not used as a ration, 6071.

"NORTH STAR," H.M.S., 1852-54.

Dr. Toms—

Hard work in "North Star" cutting docks, 3579; tracking along the ice not so hard as the ice saw work, 3585-6; hard work in winter fetching coals and provisions, 3587; on her beam ends, for how long, attendant circumstances, 3663; number of her crew and arctic service, 3676-7.

Mr. Bayley, 1848-49—

Passed the winter unexpectedly, 6255; ship not prepared for wintering, frozen in eleven months, 6312-13.

Rear-Admiral Pullen, 1852-54—

Her dangerous position when on shore, 6210; she had two decks, the main used for berths, the lower for work, 6215; advantage of this, 6216.

NURSING. [See *Scurvy, Treatment of.*]

O'REGAN, MICHAEL, A.B., of "Discovery"—

Lieutenant Rawson—

Case of scurvy, 1147; improvement in seal meat and lime juice, 1148; state of health on arrival on board ship, 1150; how far recovery due to seal meat, 1090-92.

Dr. Nimis—

Case of, after sledging in North Greenland, 2567-9.

Dr. Coppinger—

His case, 2749.

OSBORN, REAR-ADMIRAL SHERARD—

Dr. Toms—

His opinion about taking lime juice sledging, 3756.

Dr. Lyall—

Lieutenant Osborn when sledging from "Assistance," in 1852-4; had symptoms of scurvy, was better on return, 4358-60.

Admiral Ommanney—

Sufferings of party from snow-blindness, 5892.

OX-CHEEK. [See *Meat.*]

"PAGODA"—

Dr. Dickson—

His experience as medical officer in charge of the "Pagoda" in the antarctics from December to April, 1844-5, number and size of icebergs, 5673; and thermometer seldom below + 20, 5675.

PAUL, CHARLES W., A.B., of "Discovery"—

Commander Beaumont—

Treatment by Dr. Coppinger, 934; offensiveness of breath in tent, 976; what remedies he tried, their failure, 979; death, 1100.

Dr. Coppinger—

His case, 2746-8; constitution utterly broken with scurvy, 2944; but otherwise fair, 2945.

PEMMICAN.

Papers in Appendix and with Report.

Analysis of, by Surgeon-Major De Chaumont No. 23.

" " Professor Frankland. . . with Report.

Evidence.

Sir G. Nares—

Some people cannot eat it, 43.

Captain Stephenson—

Men did not eat it all at first, 338; allowance of, ample, 340.

Captain Markham—

Not at first on full allowance, 591; being unable to eat it, 592; or to cook it, 730-31; all took kindly to it after a week, 729.

Commander Beaumont—

American pemmican coarse, with more fat and currants, 955; want of appetite when first sledging, from dislike of pemmican and fatigue, 961.

Lieutenant Rawson—

It was very good, 1164; the American much coarser, 1165.

Commander Aldrich—

Excellent, but not suited to all, 1303.

Commander Parr—

Both plain and sweet carried, 1492; it had to be eaten with salt, 1493-5; did not produce thirst, 1498; sick men preferred bacon, 1497.

Dr. Colan—

Two kinds, 1782; the plain generally used, 1783; account of preparation of both kinds, 1784; it did not produce thirst, 1786.

Admiral Richards—

In early sledge travelling some days elapse before men eat it, 3187, 3223.

Captain Hobson—

It was taken sledging from "Fox," 3482.

Sir L. McClintock—

That used in the late expedition the same as in his, 3350.

Captain A. Young—

Eaten raw sledging from "Fox," 3788.

Dr. Macdonald—

More than required if all consumed, 4862; not liked by all, 4863.

Dr. De Chaumont—

No antiscorbutic properties except lactic acid in the flesh, 5136; that mixed with raisins and currants would have,

PEMMICAN, *continued*—

5137; and would account for exemption of Americans from scurvy, 5138.

Dr. Payy—

Is rich in albuminates or fat, 5186.

Mr. Busk—

The mixture of currants with American pemmican might give it antiscorbutic properties, 5275-6; it creates thirst, 5255; apparent repugnance of men to it, 5249.

Admiral Ommanney, 1850-51—

Want of appetite for it, 5907; preference for pork, 5907; herbs, not currants, used to be in it, 5908, 5915-16; description of its preparation, 5908-9.

Captain Feilden—

Used it sledging in recent expedition, 6039; ate his own allowance and sometimes more, 6040; mixed it with potatoes and cooked it, 6041-4.

Rear-Admiral Pullen, Former Expeditions—

It was made in England, some had currants and sugar, plain preferred, 6175-6; in winter quarters, 1850, found some flour and pemmican, 6119.

Mr. Bayley, 1852-54—

How it was cut and weighed for sledging, 6288; it was of three kinds, with currants, sweet and plain, 6380-81.

J. Organ—

Sledging from "Assistance," how it was carried, 6666, 6692-3; and issued in turn, 6667; the currant kind most liked, 6668.

Dr. Barnes—

Pemmican not antiscorbutic, has no faith in it as meat, 7062.

Alexander Gray, Ice-quartermaster—

It was very good, 7450-56; and liked at first, 7450, 7455; the sweet best, 7457; how the pemmican was cooked, 7458.

Thomas Rawlings—

It was liked, 7736; the sweet preferred, 7757-8.

Mr. Emmersou—

Heavy feeding, could not eat it all, 8299, 8300.

William Jenkins—

Very substantial, 8498; had no appetite for it, or preserved meat when ill, 8398, 8402; did not eat it for some time, 8486.

Dr. Rae—

Method of making it by the Hudson Bay people, 8772; description of the service berry sometimes put into it, 8772-5; he and his men could always eat more than their ration, 8778; it was eaten cold in the morning, cooked at night, 8806.

Mr. Mitchell—

In "Discovery" plain and sweet, 8925; only that at Polaris Bay had currants in it, 8926-7; it was all consumed, 8929.

Sir A. Armstrong—

To what extent with currants it is antiscorbutic, 9164; but prefers it plain, 9169; what they had in "Intrepid," did not like the sweet, 9170.

PESHAWAR—

Dr. Munro—

Peculiarity of the Peshawar fever, 8555.

PETERSON, N. C., of "Alert," the Dane, Dog-driver and Interpreter—

Sir G. Nares—

Over standard of age, had wintered before in the arctic, 149.

Lieutenant Rawson—

Illness due to want of quick circulation, 1043-8, 1126; too old for low temperature, his age, 1127; as well clad as the others, 1047; his symptoms, 1128-33; had been in previous expeditions, 1132; was suffering from frost-bite, 1133; measures to protect him when ill, 1134.

Dr. Colan—

Death, 1624, 1688; illness began in March when sledging, 1625, 1692; not ill in winter, 1626; his congestion of the lungs not due to scurvy, 2032-3; appearance of scorbutic symptoms in April, 1691-3, 1704-5; was not surprised under the circumstances, 1705; his treatment, want of fresh meat much felt, 1694; how far his appetite failed, 1695; what vegetables were given, 1696; lime juice was given him when ill, 1700-1701; and before, 2118; extra allowance after appearance of scurvy, 1702; one ounce before, 1702-7; thinks now that a larger quantity was necessary to prevent scurvy, 1706-8.

PIM, LIEUTENANT BEDFORD, now Captain—

Sir A. Armstrong—

Roscoe of "Investigator" by Lieutenant Pim, travelling in very low temperature, 8931, 9223.

"PIONEER," H.M.S., 1852-54—

Sir G. Nares—

Warmed in the ordinary way, and considered preferable to Sylvester stove, used as an hospital ship, 9303.

Dr. Toms—

Comments of her, 3699.

POLE, NORTH. [See *Arctic Exploration.*]PORK. [See *Meat and Diet.*]

PLANTS.

Antiscorbutic, in the arctic regions .. Appendix No. 26.

PORTER, GEORGE, Gunner R.M.A., of "Alert."

Captain Markham—

Death of, 583-9, 631; suspected symptoms of scurvy in this case, 599.

POTASH.

Dr. Macdonald—

Nitrate of potash is not an efficacious antiscorbutic, 4859, 4889.

Dr. De Chaumont—

Present in large quantities in non-antiscorbutic foods, 4983-4.

Dr. Pavy—

Does not contain antiscorbutic properties, 5243-5.

Dr. Barnes—

The potash compound is a substitute for lime juice broke down, 7155-6.

POTATOES. [See *Vegetables, Diet.*]PROVISIONS. [See *Diet.*]

List of, supplied to and returned by the arctic ships; with report.

"RATTLESNAKE," H.M.S.—

Captain Hobson—

Latitude in which she wintered, 3516.

RAYNER, ELIJAH, Gunner R.M.A., of "Discovery"—

Commander Beaumont—

Injury to leg not due to scurvy, 1069; the only man sound in his crew on return, 1078.

RECREATION AND AMUSEMENTS—

Recommendations of Medical Director-General, Appendix No. 2.

Evidence.

Sir G. Nares, "Alert," Exercise—

Cheerfulness of crew in winter, 236; large space devoted to recreation and comfort, 236; no one held back from amusements, 237; school fully attended, 237; no games or amusements outside in either "Resolute" or "Alert," 9379-80.

Commander Beaumont, "Discovery"—

Attention paid to promotion of cheerfulness, 1186.

Mr. Bayley, "Assistance," 1852-54—

What amusements provided, 6485-88.

Vice-Admiral Ommanney, 1850-51—

Large amount in "Assistance," 5898.

Mr. Murray, "Enterprise," 1850-55—

A skittle alley and billiard room built, which was used in bad weather, 6895; lower deck being kept clear, 6896; employment of evenings, 6897.

Alexander Gray—

Was very happy during the winter in "Discovery," 7310, 7314; the men generally very happy, 7315; and plenty of amusement, 7316; amusements on board the whaler, 7567; dancing with Esquimaux, 7567.

REGAN, M., A.B., of "Discovery." [See under *O'Regan.*]

"RESOLUTE," H.M.S.—

Sections and plans of, with cubical contents, Appendix No. 22.

Evidence.

Joseph Organ, 1850-51—

More comfortable than the "Enterprise," 6550; wintered near Griffith's Island, 6800; not a better position than the "Enterprise," 6801; about like "Assistance" in accommodation, every comfort in each, the "Enterprise" not equal, 6558-9, 6795.

RICHARDSON, SIR J.—

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Dr. Rae—

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Recovery of men in his crew due to rest, change of diet, fresh meat and lime juice, 898-900; treatment by Dr. Coppinger, 934; what remedies he himself tried, their failure, attempt to ease sick of labour, 979; the sick men endeavoured to repress depression of spirits, 980; disappointment at want of effect of lime juice, 990; how far lime juice was beneficial, 898-900, 1000.

Lieutenant Rawson—

Arrangements as to lodging and diet at Thank-God Harbour, 1080; treatment of Hand, 1145; condition of G. Bryant and M. O'Regan, 1147; improvement on seal meat and lime juice, 1148; state of their health on arrival on board ship, 1150; recovery of men how far due to seal meat, 1090-92, 1100.

Lieutenant Giffard—

What remedies he gave, 1215; sick men asked for lime juice, 1224; supplied to them, 1225; did not improve under it, 1226; ultimately recovered, 1227.

Commander Aldrich—

Gave lime juice after finding it at Cape Colan dépôt, 1355-6; was taken with pleasure by sick men, but did no good, 1397; how he managed his issues, gave over the ration, 1398; was ordered to use scurvy-grass and sorrel, if obtainable, 1291-2; but did not get any, 1292-3; unable to give relief when scurvy was recognised, 1354; danger of looking for sorrel for fear of the thaw, 1355.

Commander Parr—

Lime juice carried when sledging for the sick, 1447, 1487; used when symptoms proved to be scorbutic, 1432; difficulty in thawing it, 1433; how and when administered, 1434; how long continued, 1435; what remedies were given, 1430.

Lieutenant Egertou—

Lime juice was regularly taken by the Esquimaux who had scurvy, 1563, 1593; taken by Esquimaux from day of starting, 1594; remedies applied, 1606.

Dr. Colan—

Want of fresh meat much felt, 1694; what vegetables were given, 1696; lime juice was given to Petersen when ill, 1700-1; and before, 2118; extra allowance after appearance of scurvy, 1702; one ounce before, 1702-7; thinks a larger quantity was requisite to prevent scurvy, 1706-8; extra allowance was given to G. Kemish, wardroom steward, for fear of scurvy, 1720-21; was supplied to Kemish and Burroughs regularly before their attacks, 2118; increase of allowance given to G. Burroughs when suspected of scurvy, 1824; dates of increase, 1825-30; up to three ounces a-day given in treatment of other patients, 1993-6, 2071; men mended under it, 2071; description of the treatment, chiefly dietetic, 1989-90; men sent on deck when weather got better, 1992; a good temperature kept up in steerage, and disinfectants used, 1992; advantage of fresh food and lime juice, 1992; remarkably beneficial effect of fresh meat, 2184; the amount he was able to give, 2185; preserved provisions given, 2186; allowance of potatoes doubled in treatment, 1995.

Dr. Moss—

The medical comforts he took when he went to the relief of the northern sledge, 2372-3.

Dr. Ninnis—

Lime juice was given to invalids as soon as they came under medical care, 2658; from two to eight ounces a-day given to sick, 2696; eight ounces readily taken, 2697; beneficial effect of administration, 2699-2700; the treatment adopted greatly dietetic, 2648; two deaths, 2649; one not under medical care, 2650; length of illness before treatment, 2652-7.

Dr. Coppinger, "Polaris"—

Lime juice was used in eleven cases of scurvy, 2892; and was good, 2894; invalids recovered under it more rapidly than Shepherd under the navy juice, 2897; want of improvement in Lieutenant Beaumont's crew till supplied with fresh meat, 2974; advantage of kidney-sorrel in treatment of cases at Polaris Bay, 2974-6.

Sir L. McClintock—

Treatment could not be given sledging, 3326.

Dr. Pavy—

Improvement in sick at Polaris Bay due to fresh meat, they having no medicine except lime juice, 5153-4.

Mr. Busk—

To what extent the fresh meat supplied at Polaris Bay was a curative as well as the lime juice, 5268.

SCURVY. 3. Treatment in Recent Expedition, *continued*—

Captain Feilden—

Treated himself, 6001; had a double allowance of lime juice, 6002.

Alexander Gray—

A change of diet the best cure, 7583; treatment with lime juice of his party and their improvement under it, 7503-7, 7584-5.

Thomas Rawlings—

Treatment of his party, 7791-3, 7807; extreme attention of Dr. Colan, 7799-7807; who made himself ill by overwork, 7808-9.

Color-Sergeant Wood—

Treatment on board ship, 8032; the steerage used as a hospital, 8033; account of nursing, 8036-39; much attention wanted, being very helpless, 8038-9, 8049; Dr. Colan and Dr. Moss very attentive and hard worked, one of them present night and day, 8039-46; their time all occupied by the cases, 8044-5; what assistance they gave in nursing, 8047-52; convalescent men assisted in nursing, 8078; the working hands were too few and too busy to be able to help, 8079-80; treatment with lime juice, 8053-4; advantage derived from it, 8055; before arrival of relief party had been having lime juice for some days, 8026-7; did good, 8028.

William Jenkins—

Treatment in his own case, 8397-8401; treatment with lime juice, 8397-8401, 8403-4.

4. Causes of, in Recent Expedition—

Sir G. Nares—

Two men who were below standard height suffered from scurvy, 9, 12; chiefly due to severe labour in sledging, 137, 155; and rough and heavy roads, 144; men predisposed to it, but it was brought out by hard work, 153, 155-6; due to hard work, 9343; not to weights, 9343; causes acting in the sledging crews would not increase in ratio with advance to the pole, except as regards light, 9349; does not attribute scurvy to darkness or cold, 146, 9349-53; nor would hard work have produced it with men properly dieted, 9354.

Captain Stephenson—

Absence of light, to what extent it may cause scurvy, 397, 403-5; it was attributable to many causes, 404; absence of light not one of the most important, 405; but some importance must be attached to it, 427; hard work and exposure sledging after long dark winter and damp, 429; dampness of clothes of men going to bed, 434; might have escaped it if there had been no sledging or very hard work, but it belongs to arctic service, 435.

Captain Markham—

Darkness, dampness, and want of fresh food the predisposing causes, 691, 779; attributable to these and cold and hard work, 779; would have occurred without sledge travelling, but not to such an extent, 692; labour of sledging developed disease, but not a predisposing cause, 727; one of the first cases, a man who did not take to his food kindly, 729; did not appear till he had passed limits of autumn travelling, 711; the quantity of provision issued did not contribute to outbreak, 732; it attacked three men who did not travel, 736-7; the difference in the number of cases due to fresh meat on board "Discovery," 772.

Commander Beaumont—

Fatigue of drag-rope conduced to attack in his own case, 986.

Lieutenant Rawson—

Attributable to darkness, dampness of decks, sleeping in cold, 1119, 1157.

Lieutenant Giffard—

Want of fresh vegetables and meat, and long absence of sun, 1242.

Commander Aldrich—

Earlier attack of northern party due to rough road, and consequent sudden jerks, 1270.

Commander Parr—

Immunity due to not working so hard at first, 1452; imagines his good appetite and good health reacted on each other, 1507; due to prolonged absence of the sun, 1455-7, 1460, 1480, 1508; and to confinement and dampness, 1460; and want of sufficient of the food calculated to keep off the disease, 1474-8; insufficiency of food the primary cause, 1479; comparative exemption of George Winstone, who smoked and chewed tobacco, 1469-72; the hard work an aid, not a cause, in producing the disease, 1509-10; does not attribute it to cold, 1511.

Dr. Colan—

The remote causes absence of fresh vegetable food and fresh meat, 2000; the predisposing causes, long absence of sunlight, damp, and cold, 2000, 2077-8; exciting cause the physical exertion of sledging, 2000; definition of these terms, 2004-6; predisposing causes weakened the men, but had no obvious effect, 2001-3; how far physical exertion was an exciting cause in the ship's steward, 2007-11; difference in sledge diet and absence of lime juice may account for it, 2012-14; symptoms developed in proportion to absence of men, 2057, 2125; the hard work influenced the severity of the symptoms,

SCURVY. 4. Causes of, in Recent Expedition, *continued*—

2058, 2125; to what extent darkness predisposed them to sickness, 2077, 2144-5; prolonged absence from vegetable juices the essential cause, 2080; is not a disease of incubation, but there may be gradual depravation of blood, 2086; comparative immunity of "Discovery" due to less sledging, 2106; and larger supply of fresh meat, 2110.

Dr. Moss—

The late expedition was exposed to increase of arctic conditions without proper prophylactics, 2448-9; the prophylactics meant fresh meat and lime juice, 2451; both in the ship and sledging, 2450.

Dr. Ninnis—

Occurrence in spring, not winter, due to intense cold in spring, longer deprivation of fresh vegetable and animal food, absence of sun and exercise, and excessive labour sledging, 2586-7, 2718; not to difference of diet whilst on board, 2588-92; omission of fresh meat and lime juice probable causes of scurvy, 2595; fresh meat in sufficient quantities would have prevented it, except for the severe labour, 2595-8; comparative immunity of "Discovery" over "Alert" due to fresh meat, 2668-77; the only appreciable difference between the ships being in the diet, the work much the same, 2678-9, 2682; the exposed position of "Alert" and increased darkness may have conduced to scurvy, 2694.

Dr. Copping—

Length of darkness and great cold predisposed the men to it, the severe sledge work and absence of fresh vegetable and animal food excited it, 2817; it was attributable to a combination of causes, 2970; sledge travelling also may be only a predisposing cause, but the difference is technical, 2820-21; how far absence of light was a predisposing cause in Shepherd's case, 2834-7; the men would not have been less subject to it a second year, 2971; comparative immunity of officers due to difference in sledge work, 2972-3; amongst the officers the nature of the physical work had some bearing on the disease, 2973.

Captain Hamilton—

Outbreak in recent expedition due to long absence of sun, want of Sylvester stove, difference in diet on board, youth of crews, 3039-40; not to want of lime juice, or severe sledge travelling, 3039; seeds sown before sledging, 3039; reasons for supposing so, 3045; remarks upon the cases, 3045; it originated in the winter, the travelling hastened and aggravated it, 3068.

Admiral Richards—

To what the outbreak in the recent expedition was due, 3161, 3232; attributable mainly to heavy labour encountered, 3182-3, 3232; dragging heavy weights over very unfavourable ice early in the season overtaxed them, 3232; to what extent great prostration would produce the disease, 3187; occurrence of prostration in recent expedition according to unfavourable conditions, 3188; men who did not undergo extreme labour not attacked, 3189.

Sir L. M'Clintock—

Attributes it to dampness and want of vegetables, 3330, 3365-6; its seeds sown before sledging, 3325, 3370; is not in a position to account for the outbreak, 3369.

Captain Hobson—

Cannot form an opinion as to outbreak in recent expedition, 3540.

Dr. Toms—

Not to excessive cold, or fatigue, or absence of light, 3730-32; similar conditions of cold and fatigue existed in his expeditions, 3730-31, 3760; also anxiety, 3760; moisture and impurity of air would not produce it in healthy men, 3733; but would tend to do so, 3733; some weakening cause must have existed before leaving the ship, 3760.

Dr. Scott—

To cold, dampness, darkness, and other causes in winter, 3978-4010.

Mr. Ede—

Cannot express an opinion upon the causes of the recent outbreak, 4258-9.

Dr. Lyall—

May have been partly attributable to the long absence of light and greater degree of cold, possibly to greater dampness, 4323-4, 4377; or less exercise than in former expeditions, 4324; but those conditions are not necessary antecedents, 4378-80; cannot give any opinion as to any further cause, 4381; to what extent the longer darkness on board the "Alert" may have caused a more severe outbreak, 4430-41; it could not have accounted for it altogether, 4437; there must have been some other cause operating, 4441.

Dr. Piers—

The outbreak to be sought for in the ships before sledging, 4557, 4667; belief of its being in the men before they left the ship, as it broke out so very soon, 4689; modification of this opinion, considering that the men were examined and found healthy before leaving, 4690.

SCURVY. 4. Causes of, in Recent Expedition, *continued*—

Commander Cameron—

Due to damp and hard work sledging, 4784; these causes would bring it on with any predisposition, 4785.

Dr. Macdonald—

Was owing to physical endurance of the men being overtaxed sledging, 4860; and elimination of antiscorbutics from the diet, 4922; no other result could be expected if the service were continued long enough, 4922; possibility of depression of young men in difficulties corresponding with their enthusiasm, it would favour defects in the sledge diet, 4861; absence of light would predispose to, but not cause scurvy, 4866; the darkness, cold, dampness, and bad air only predisposing causes, 4910; the true cause, absence of fresh vegetable food, 4912; cases occurring on board may be accounted for by dietary conditions, 4923.

Dr. De Chaumont—

The work in the recent sledging expeditions would not produce scurvy with antiscorbutic food, 5019; work has been done under similar conditions with immunity, 5020; and more, 5021; in the recent sledging expeditions, scurvy appeared earliest in Markham's party, 5010; it was not recognised for some time, 5022; not surprised at its appearance under the circumstances, 5023; was due to want of antiscorbutics when sledging, 5023, 5063; helped by excessive work and prolonged darkness, 5063; difficulty in explaining the occurrence of a case within fourteen days of leaving the ship, 5049; probably due to loss of lime juice and other antiscorbutics, 5049; other predisposing circumstances may have existed, 5050-51; the long absence of light would predispose men to it, 5052-3; and the foul air and length of darkness were principal predisposing causes, also the extreme cold, 5081.

Dr. Pavy—

The immunity of the officers due to greater change of diet on board in the winter, 5164-9; extent to which the cases occurring on board may have been due to sledging or to other illness, not to the ship dietary, 5176-9; to be anticipated with long continuance of the sledge diet even without confinement in the winter, 5190; was caused by the absence of vegetable product in the sledge dietary, 5216.

Mr. Busk—

Men did not start in good health, 5249; men leaving favourable conditions of life had to face extreme cold and discomfort and unprecedented exertion, on a diet not palatable, which they did not consume, 5249; these conditions account for the consequences, 5249; the men must have been of unusual strength to resist for weeks such labours and exposure on the sledge diet, 5249; impossibility of long maintaining health on it, 5429; sledging for a length of time under the conditions of the late expedition impossible, 5255; two months under such conditions would have exhausted any man's strength, 5284; the amount of energy required of them could not be supplied by the diet, 5256; absence of light not a predisposing cause, except in producing a depressing effect, 5290.

Dr. Guy—

Circumstances in the late expedition, confinement, dampness, bad air, and other conditions, must have impaired the health of the men, 5351-2; under the conditions of the recent sledging, no dietary or antiscorbutics that could have been carried would have prevented it, though it might have been postponed, 5410-12; the antiscorbutics carried in the ship did prevent the disease on board, except in one instance, proving the advantage of the diet, 5413.

Dr. Buzzard—

(1) To the rations of vegetables and lime juice being slightly insufficient, and to the consequent gradually accumulating deterioration of nutrition throughout the winter, 5454; present before the sledges started, 5456; (2) to the taking away lime juice when sledging, when already scorbutic, 5454; (3) to the intensifying of the qualitative deficiency of the food by the circumstances (exertion and cold) of sledging, 5454. The double allowance of lime juice given on board the "Alert," 5458-60; the immunity of the officers was due to the better diet with fruits, milk, butter, &c., 5455; existence of scurvy before starting partly shown by anæmic condition, 5455; and the early symptoms probably escaped the notice of medical officers, 5455; the long confinement would predispose to it, 5462; the vitiated atmosphere due to confined space might impair assimilation of food, 5463, 5516; without producing any obvious effect on the men, 5464; they might be apparently well and heavier in weight, 5465; men under conditions of the recent sledge parties sure at some time to become scorbutic, 5495.

Mr. Leach—

The conditions of darkness, cold, &c., only predisposing causes, 5604; the immunity of officers similar to that in the merchant service, and due to superiority of stamina, diet, clothing and education, 5607-9; the extreme exertion of the sledging parties increased the severity, but did not originate the disease, 5610-11.

SCURVY. 4. Causes of, in Recent Expedition, *continued*—

Dr. Dickson—

The immediate cause want of vegetable food or lime juice, 5619; absence of light, comparatively unwonted diet, cold and inaction, predisposed the men to it, and cold and discomfort sledging developed it, 5620-21; but could not by themselves have resulted in it, 5659; the hard work hauling sledges had much to do with it, 5697; the greater immunity of the officers due to being better fed and lodged, and probably less exertion when sledging, 5694; possibly to more attention to ablutions, 5696; and to their more intellectual amusements, 5697; or influence of higher education, 5698; greater immunity of "Discovery" due to fresh meat, 5695.

Vice-Admiral Ommanney—

Opinion upon it, 5782-5; importance of ventilation, exercise and regular hours for meals, 5782; darkness, fatigue and cold would tend to produce it, 5783, 5845; excess of fatigue not necessarily accompanied with it, 5784; might tend to produce it, 5845; not to want of lime juice, 5785; a bad atmosphere, with all apertures closed, conducive to scurvy, 5846-9; difference between officers and men possibly accounted for by different atmosphere, 5856.

Captain Feilden—

Attributes his case to hard work dragging whilst wading, 5945-6; the length of absence of sun might have had something to do with the outbreak, 5972-3.

Rear-Admiral Pullen—

Outbreak possibly due to the necessary confinement, 6201.

Mr. Bayley—

Men not enough exercised, 6324-6.

Mr. J. Organ—

Perhaps due to bad ventilation or want of exercise, 6582; reasons for thinking they had not enough exercise, 6784-7.

Mr. Murray—

Due perhaps to want of vegetables, 6909; 7013; or to depression of spirits and want of perseverance when travelling, 6950-51, 7003-4; his own immunity due to exercise, 6921.

Dr. Barnes—

Due to defective amount of vegetable food, sledging, fatigue and cold, 7044-5; its early appearance sledging not surprising under previously unhealthy conditions of life, and diet not sufficiently antiscorbutic, when called on for extraordinary exertion, on a deficient diet, 7068, 7072; special training would not have warded it off, 7070; it must have occurred under the diet on board, 7072; immunity of officers due to same causes as their immunity in merchant ships, 7092-3; comparative severity of attack in "Alert" due to health being more broken down by deteriorating circumstances before sledging, 7094-5; pallor of crews after winter denotes degradation of blood, and impairment of nutrition, 7103; a crew quite fresh from England would have withstood the sledging for two or three months, 7106; had the expedition wintered in more southern latitudes it would have withstood the disease longer, 7107; the comparative absence of vegetables undermined the system, and absence of lime juice hastened the outbreak, 7109-10.

Mr. Emmerson—

Not to damp, 8163; to hard work and want of vegetables and blood meat when sledging, 8366-8.

W. Jenkins—

Attributable to cold, limited kinds of provisions sledging, monotony of diet on board and preserved provisions, 8496-7; any sledge party going over the same ground would have scurvy, 8499.

Dr. Munro—

The cold and fatigue in the late expedition enough to produce scurvy, 8607.

Dr. Rae—

The outbreak possibly due to too little exercise, 8841; the double allowance of grog and the increase and then stoppage of lime juice, bad, 8841; also stopping for tea in the middle of the day, thus causing stagnation of blood, 8841; also sheltering in tents, 8841; perhaps to overwork, 8885.

Sir A. Armstrong—

The conditions of the winter did not produce scurvy, 9125-6, 9156; and would not do so, 9126-8; absence of light would not account for difference in number of cases in the two ships, 9130-31; overtaxing of strength would not have produced scurvy without the absence of lime juice, 9142; due to overwork and absence of lime juice, 9141-3; and exhaustion preventing the men eating their food, 9143; with consequent waste of strength it would occur rapidly, 9150-56; suggestions for accounting for its occurrence in the cases due to sledging, 9158, 9250-62; similar cases never occurred on board the "Investigator," but the prescribed exercise not taken on board "Alert," 9262; no scorbutic taint existed among the crew, 9159-60; did not anticipate scurvy if his suggestions had been carried out, informed Captain Stephenson before leaving he need not expect it the first and second winter, 9267-68; the sledges should have returned on outbreak, 9277, 9300.

SCURVY. 5. Former Expeditions, *continued*—

Sir G. Nares—

"Investigator" in better health as to scurvy the fourth than the third winter, 139; special reasons for this, 140; outbreak in Sir J. Ross's party when sledging, 166; considers scurvy really existed in the former expeditions though not recognised, 203; instance of attack men in Dease and Simpson's expedition on a walking party of ten days, recovery on return to their boats, 9343; similar instance in Sir J. Richardson's expedition, 9843; notwithstanding the fresh meat, 9343; immunity not confined to Sir L. McClintock, 9303; but former journeys not safe precedents, 9359; previous breakdowns in sledging attributed with one or two exceptions to debility, 9330; recognises the existence of more scurvy in previous expeditions than was supposed at the time, 9332; instance of "Investigator's" crew, though scorbutic, being better on return from sledging, 9354; the smooth roads of former expeditions more in their favour, but the crews equally enthusiastic, 9360; extent to which scorbutic symptoms may have existed in the "Resolute," 9361; travelling had knocked the men up at the end of the second year, 9361-2; has never seen scurvy except in the arctic, 9374-5.

Captain Hamilton—

Symptoms in his journeys, 2996-7, 3055, 3066; no man broke down from it, 3055, 3066; no symptoms of it (letter of G. Murray), 2996; no scurvy in Ross's expedition, 1849 (letter of G. Murray), 2996; most of Lieutenant Mechem's men had sore ankles and feet, due to over marching, 3056-7; how far a case occurred in Mr. Nares' sledge, 3063; no more debility than to be expected from the circumstances, 3067; recovery of "Investigator's" crew when supplied with fresh meat, 3037; they all had scurvy when they came to "Resolute," 3058-9.

Admiral Richards—

His men were distressed especially by walking in water, 3104, 3196; but he had only one (or two) case of scurvy, 3104, 3195; the man started in bad health, and was sent back, 3105; no man fell out except for snow-blindness, 3106; or was unable to drag, 3196; it was never thought of, 3134; health of the crew in 1853, extract from journal, 3135; falling off in 1854 of men fit for extended sledge work, 3135, 3160; the men very weak when they came on board the "Phoenix," 3157-60; cannot say whether with scorbutic symptoms, 3158; considers them not free from it in an incipient state, 3201; unfit to pass another winter in the arctic, 3159; good fortune of Belcher's expedition in exemption from disease, 3184; immunity due to fair start, over good ice, and consequent seasoning of men, 3234; his party had no greater immunity than others of the same expedition, 3234.

Sir L. McClintock—

No scorbutic symptoms among men in his journeys, 3248; their immunity due to their being exercised before starting, and to the diet not being salt meat, 3249; attack on board the "Enterprise" and "Investigator" in 1849, 3270; not very severe, 3271; three deaths due to it, 3271; what its extent was, 3272-5, 3278; appeared in the winter, 3277; no sledge party had it, 3276; was due to bad preserved meats, hard work carrying ballast, damp and discomfort of "Enterprise's" lower deck, 3278, 3365-6; also want of vegetables, 3365; remedies applied, 3330; treatment of scurvy, it could not be given sledging, 3326; the "Investigator" the more healthy ship, having a better lower deck, 3279; two officers attacked in "Enterprise," 3291; great benefit derived from eating sea birds, 3391; crew of "Intrepid" weak when they came on board the "Phoenix," 3315.

Scurvy on board the "Fox"—

One officer attacked, 3291; death of engineer due to apoplexy, 3293-4; Captain Hobson ill of it before starting on the journey on which he suffered, 3352-3; dietary with which he was treated, 3354; case of Thomas Blackwell, ship's steward, 3355, 3399; what other cases he had, 3358.

Captain Allen Young—

No men in "Fox" treated for it, 3767; debility on third journey due to exhaustion, 3768; not to scurvy, 3793; account of his attack of illness, 3794, 3840-48; his companion on the third journey frequently fainted, 3834; but believes he went with him on the fourth journey, 3851; immunity from scurvy due to discipline of ship, exercise, and the ship being kept dry, 3769; exhaustion of himself and party on return from fourth journey, 3853-4.

Captain Hobson—

All his men in sledging from "Fox" in spring had scorbutic symptoms, 3413, 3423, 3484; no signs in autumn journey from "Fox," in spite of great exposure, 3421-4; in the spring debility came on before leaving the ship, 3425; had scurvy himself, account of case, 3426, 3431, 3445, 3480, 3489, 3526-35; no one suspected scurvy, 3525; the whole party attacked, but himself worst, 3492; the men were debilitated from want of fresh meat and vegetables,

SCURVY. 5. Former Expeditions, *continued*—

3429; no obvious symptoms, nor were they prevented from work, 3495; was himself able to get about after return to the ship, 3495; they recovered with change of diet and fresh meat, 3495, 3505-6; and lime juice, 3508; none when in Behring's Strait ("Rattlesnake") owing to fresh meat, 3417, 3450, 3518-24; and to comparatively low latitude, 3518, 3524; had none himself then, 3446; smoking too much may have predisposed him to it, 3535; but observed no similar effects among other men of "Fox," 3536; had a craving for raw meat and fat, 3543-6; but could not eat seal blubber, 3546.

Dr. Toms—

Exemption in his expeditions due to careful manner in which lime juice was taken, 3760; health of "North Star" perfect, 3576, 3661; death of two men of northern division, neither from scurvy, 3576; no case, 3577, 3601, 3660; either in "North Star" or "Pioneer," 3599, 3698; man of Franklin expedition whose corpse was dug up, 3638-41; probably died of consumption, not of scurvy, 3641; fear of it when "North Star" was on her beam ends, 3662; men of "Pioneer" healthy on return from sledge travelling, 3598, 3698; were in good health when taken on board the "Phoenix," 3600; they suffered from slight frost-bite, 3711; reasons for immunity from scurvy, 3723.

Dr. Scott—

The health of his men very good, 3910; no scurvy, 3916; exemption due to fresh meat, lime juice, pickles and vegetables, 3917; the conditions of darkness, cold and damp not intense, and fresh meat was obtained, 3996-7; deprivation of vegetables did not produce scurvy in "Intrepid's" sledge parties, 3999-4000; they were thinner from exertion on return, but healthy, 4000; the health of Belcher's expedition on leaving, very good, some could have stayed out, 3941; the seeds of it may be sown without being observable, 3982; the scurvy cases he saw were in the "Investigator's" crew, 4020-22; their symptoms, 4023; and treatment, 4023; in his sledge journey there were no scorbutic symptoms, but men had only just arrived from England, 4038-9.

Mr. Edce—

Had no traces of scurvy, 4065; no scurvy in his sledging party, 4095; nor scorbutic symptoms, 4263; treated men for frost-bites and snow-blindness, 4096-7; brought back some cases of frost-bitten and snow-blind men from other sledges, 4171; they had no scorbutic symptoms, 4172-9; the crews in very good health on their return, 4113; could have stood another winter, 4114-15; reasons for immunity, lime juice, ventilation, exercise, and eggs they obtained, 4127.

Dr. Lyall—

No case of scurvy in the "Assistance," 4287; but some signs of, 4287; did not connect it with not drinking lime juice, 4294; not restricted either to the ship or sledging, some cases occurred sledging, but partially recovered before return, 4344; when taken on board the "Phoenix" many had scorbutic taint, 4320; there would have been more after another winter, 4321; but they were comparatively free the first winter and season, 4322; several cases in the following year, 4361; on board the "North Star," from crews of deserted ships, 4362-4; very little exertion brought out scurvy in their condition, 4365; Captain Richards' men had swelled ankles, but all men were working, and soon recovered, enough to account for it in exposure wading, 4419, 4420; comparative immunity of "Assistance" due to cleanliness, decks being kept dry, and compulsory exercise, 4427; the shorter period of darkness may have affected the case, 4428; one man sent back from sledging had undoubted symptoms, but it was not put down to it, 4356; Lieutenant Osborn and one of his crew had symptoms, but they were both better when they returned, 4358-60; some symptoms in his journeys which he could attribute to it, 4426; had no scurvy in the antarctics, 4335; good state of health in the "Antarctic," though five months in the ice, 4412.

Dr. Piers—

In "Investigator" it might have been retarded, if not avoided, had the full ration of lime juice been maintained, 4658; in spite of limited diet none in 1851, 4591; or in sledge expeditions in 1851, 4577, 4586; immunity due to condition of men, 4588-90; injurious effect of want of food the second winter, 4457-8, 4462; no scurvy before sledge journey in 1851, 4572-3; condition of the men on return from sledging, after the first winter, very good, 4464-5; deterioration of health of crew at the end of the second winter, 4469, 4602; after reduction of rations, 4602-4; scorbutic signs in the spring, 4470, 4605; scurvy appeared in May, 1852, 4470; and existed before abandoning the ship, 4569; some suspicion of it before, 4605; increased after May, 4606, 4616; incapacity of some men to drag on journey to "Resolute," 4471-2; their complaints, to what extent affected with scurvy, 4473; almost all affected on leaving the ship, 4650; reduction in lime juice and provisions conducive to weakness in 1853, 4508-9; with more food there

SCURVY. 5. Former Expeditions, *continued*—

would have been less disease, 4510; improvement on board the "Resolute," 4476, 4651; attributable to increase of nourishment, lime juice and fruits, 4477, 4483-4, 4489, 4527; and prospect of getting home, 4489, 4527, 4651-5; many went on the sick-list, 4484; but recovered in the winter, 4485; two deaths occurred; the others recovered wonderfully, 4486-7; on reaching Beechey Island, the health was much improved, 4488; scorbutic symptoms in all his party on journey to Beechey Island, 4558-67; insane appearance, 4563; flying pains before leaving the ship, 4567; four deaths in the "Investigator," 4524; none till April, 1853, 4618; three then from it, 4634; the sick list, what it was, 4617, 4635-6; improvement of men under sorrel (1852), 4619-25; would have got rid of the disease if it had continued, 4624; scorbutic taints predominant in the large amount of sickness (1852-53), 4630-31; and decided scurvy, 4632-53; inability of men to hunt in winter (1852-3), owing to debility and depression, 4638-41; their symptoms, 4642-5; diarrhoea in December, 4647; the disease due to want of food, primarily of vegetables, 4657; symptoms (and effusions) observed, 4683.

Dr. Macdonald—

Inability to account for immunity of other arctic expeditions under similar conditions, doctrines cannot be founded on negative cases, 4923-6; there must have been some difference, 4924.

Dr. De Chaumont—

Difficulty in accounting for immunity of other expeditions under similar conditions, 5124; in the case of the "Polaris" party, fresh meat would have been antiscorbutic, 5130-32; absence of fatigue another cause of immunity, 5131.

Dr. Pavy—

Immunity of Dr. Hayes's party in December due to fresh meat, 5159-60.

Mr. Busk—

Immunity of other sledge expeditions; considerations to what it may have been due, 5249; whether to difference in condition at starting, shorter darkness, more exercise and training, starting later in the season, 5249; probability that Sir L. McClintock had not occasion to use such violent exertions, 5256; immunity of Captain Tyson's party in their drift from the "Polaris" probably due to eating seal flesh, &c., nearly raw, 5271.

Dr. Dickson—

None in his voyage to antarctics, 5674-9; immunity of "Polaris" party possibly due to seal meat, 5702-3.

Vice-Admiral Ommanney—

The sick-list in "Assistance" very small, 5749; perfect health the whole time, 5756; no symptoms of scurvy, 5750, 5756, 5803-7; none after sledging, 5769, 5818, 5828-9, 5895; men examined by medical officer on return, with satisfactory result, 5826-7; slight rheumatic pains in one man, but only temporarily, 5830; immunity due to good arrangements, food, ventilation, and recreation, 5898; liability to scurvy of former expeditions owing to bad air, caused by closing every aperture, 5848.

Rear-Admiral Pullen—

No scurvy in his boat expedition from "Plover," in spite of exposure and absence of vegetables, 6087; one man was not well at starting, but would not go back, 6101; but had no scorbutic symptoms, 6102; they were in very good health, 6161; had no doctors nor medicine, 6161; men gave no signs of symptoms the second year, and volunteered to search the coast again, 6112; health of crew on return very good, he himself sick after eating and had diarrhoea, 6116-17, 6178-9; in spite of the hard work, 6180-81; no scurvy appeared, 6119; has never met scurvy, 6195.

"North Star," 1852-54, none at end of the second winter, 6214; no suspicion of it when sledging, 6234, 6241; conditions of his journeys the same as of the recent expedition, and cannot account for his immunity, 6242; personal sufferings when sledging, from snow-blindness and rheumatism, 6243.

Mr. Bayley, "North Star," 1848-49—

Believes there were no symptoms, 6251-6, 6320, 6327; crew healthy, 6250, 6321.

"Assistance," 1852-54—

No suspicion of it, 6416; it was discussed among the men on several occasions, 6489.

Mr. J. Organ, "Assistance," 1852-54—

One or two swelled legs when sledging, 6561, 6675; remained with one man in a snow hut at Cape Lady Franklin depot for twenty days, 6562-70; health at end of winter very good, no illness, 6661-3, 6687; heard of no symptoms of it in any party, 6675-78; two men died 6685-6; but no scurvy, 6688; never heard of it in all his long parties, 6585.

"Enterprise," 1848-49—

Unaware of there being cases of it, 6540-43, 6610-17, 6809-11; illness of twelve men out of forty of party sledging, 6636-43; sick men sent back, 6643-4; never heard of the disabled men having scurvy, 6651.

SCURVY. 5. Former Expeditions, *continued*—

Mr. Murray, "Enterprise," and "Investigator," 1848-49—

Is unaware of it having occurred, 6848-51.

"Enterprise," 1850-55.

Does not recollect the occurrence of it in the second journey, 6882-84; crew well the third winter, with one exception, in spite of hard work, 6888.

Sir A. Armstrong, "Investigator"—

Broke out in the spring of 1852, 9026, 9215; partly due to the reduction of lime juice, 9216; none the first year or the second till the reduction of rations, 9030; none of the crew free when the ship was abandoned, 9031, 9222; but some incapable of exertion, 9222, three deaths when in want of food, 9032; two after leaving the ship, probably due to it, 9033; a colored Canadian was ill of disease, no difference in his symptoms, 9036-8; growing scorbutic tendency in 1852 due to want of food, 9219; which diminished physical power, 9220; improvement in health on determining to leave the ship, 9225; and on board "Resolute," 9230; reasons for immunity of Sir L. McClintock's and other long journeys without lime juice, 9021, 9176; belief that symptoms did exist, and that a man died of it after two years' travelling, 9021; immunity of "Polaris" party on the floe due to raw meat, pemmican mixed with fruits, absence of exertion, and living in unvitiated air, 9162-66.

Dr. Robertson, "Enterprise," 1848-49—

Cause of personal attack of scurvy due to confinement in consequence of an accident; his symptoms, his recovery, and that of other cases, due chiefly to supply of sea-birds; mode of preparing the birds and their use as soup with potato and oatmeal; treatment for scurvy, exercise, three or four ounces of lime juice, plentiful and mixed nourishing diet; there was no regular outbreak of scurvy, but some cases returning from the sledging showed a tendency to it; no deaths occurred; the lime juice bad (letter at end of Evidence, p. 316).

6. In other than Arctic Expeditions—

Dr. Ninnis—

Surveying in Australia with no lime juice, but fresh meat and some vegetables; it appeared during reduced allowance of all things, when diet was preserved and salt meat, and want of vegetables, 2599-2625, 2631-4; recovery with plenty of fresh food and vegetables; the fresh meat being unlimited, the vegetables limited; considers the fresh meat prevented the disease, 2628-35, 2641; much meat being taken, but the vegetable unpopular, 2701.

Dr. Coppinger—

In Russia with a diet entirely of fresh vegetables, 2829-30.

Dr. Scott—

No scurvy in the navy, never saw it except in the arctics, 3966-7; men not at sea long enough now, and get fresh meat and vegetables in harbour, 3968-9, 4025; scurvy in the Crimea amongst British troops occurred with low temperature, 3991; amongst allied troops with a high one, 3992.

Mr. Ede—

In the Pacific in a frigate, though taking lime juice, after six or eight months' diet on salt meat, 4124, 4201-20; fifty men ill, and the whole crew debilitated, the provisions bad; two ounces lime juice every day, preserved potato used, the temperature over temperate, recovery after obtaining bananas and melons at Honolulu, and fresh meat and fish, 4201-20; instances he treated of agricultural labourers of about twenty, with full diet of pork, bread and beer, cured by a lemon a day, 4224-33.

Commander Cameron—

Journey across Africa—

Occurrence at the end of his journey, 4692; attacked himself, 4692; two men died, others had to be carried, 4693, 4765-6; it occurred in November after two and a half-years' journey in moderate weather, 4694-7; at a high elevation, 4698; after leaving Bihé, and after a plentiful vegetable diet in a country with wild fruit, 4701-2, 4709; no symptoms at Bihé, 4702; twelve or fifteen men out of fifty attacked, 4703, 4718; his own symptoms, pain from old bruises, 4722; the symptoms of the men, 4694, 4721-33, 4808; their feebleness and despondency, 4721-3; unhealthy look of the skin, 4726; his mouth bled, 4733-9; no personal experience of it amongst the natives, but Major Monteiro's party mention it in 1836-7, 4743-4, 4802; the men knew nothing of the disease, 4745, 4753, 4801; considered it bad blood, 4753; attributes it to too little food, hard work and wet, 4792, 4811; no disease caused by the swamps, but the rainy season affected them, 4764; and consequent death of one man, 4766; no scurvy at Kilemba, but other diseases, 4769; everyone had fever, but it did not produce scurvy, as they had been healthy just before, 4770-74; how far they were affected with other diseases, 4774; some men intemperate, but two of the worst cases drank nothing, 4775; is prevalent at fishing stations round Benguella in absence of vegetables and fresh meat, 4802-3, 4815-19, 4823; in his journey across Africa, good treatment at Benguella, at Portuguese doctor, 4738; treatment with and recovery on limes, 4738; with

SCURVY. 6. In other than Arctic Expeditions, *continued*—milk and vegetables, 4740; milk given as soon as he could swallow, 4800; blood cleared from mouth and throat, 4739; rapid recovery of himself and other men, 4741-2.

Dr. Macdonald—

In Ireland during the famine, 4845; the symptoms, 4846-7; the intellect not clear in the acute form, 4848-9; turnips were the staple article of diet, 4850, 4884; it was a starvation diet, 4885; in Australia of colonists living on fresh meat, without vegetables, 4851, 4892-3; Captain Tyson's party in their drift from the "Polaris," immunity due to antiscorbutic property of the seal meat, 4925.

Dr. De Chaumont—

Instances in the Crimean war among British troops, 4961-9; arising with deficiency of fresh vegetable food and issue of salt meat, 4961-2; greater sufferings of the French who had little fresh meat, and for vegetables, chiefly rice, 4963-6; use of dandelions to make soup, 4964; recurrence of the disease when dandelions failed in hot weather, 4968-9; the disease originated in Bulgaria, checked by grapes and vegetables procured in the Crimea, 4965; instance in Scotland with men living upon porridge, or tea and bread without succulent vegetable, 4970; their recovery on a diet of milk, broth with vegetables and potatoes, 4970-71; no great difference in the symptoms, but in the Crimea it produced dysentery, 4973-4; instance of scurvy with a plentiful diet of bread and meat only, recovery on diet of vegetables and lime juice, 5134.

Dr. Pavy—

Icelanders suffer from it, with a milk and vegetable diet, 5161-2; and use a vegetable diet as a cure, 5163; immunity of officers in the Austrian army in 1720, 5167; instance of cases with farinaceous diet, but little meat and milk, 5192; has not seen a case in a person adequately supplied with fresh succulent vegetables, 5217.

Mr. Busk—

Instance with Lascars employed on fortifications at Aden, though on a vegetable diet of rice, with butter, 5293; their recovery on a more nutritious diet, soups, &c., 5298.

Dr. Guy—

Occurrence of scurvy in gaols where men have refused, or been deprived of potatoes, 5313-14; his remarks referring to persons who have no other class of vegetable or antiscorbutics, 5313-15; instance of the outbreak at Milbank in 1823, 5333; dietary reduced from 304 to 168 ounces of solid food a-week, potato eliminated, meat and vegetables almost entirely removed, it was followed by a bad outbreak, accompanied by diarrhoea and dysentery, and these diseases recurred in spite of the diet being set to right, 5334; due to the striking off of the potato or vegetable element, 5334-5, 5354, 5386; the diminution in the total food contributed to it, 5354; the winter had been cold and damp, and the cells unusually cold, 5353; these causes would not of themselves have produced scurvy, 5354; a subsequent outbreak among military prisoners due to absence of potatoes, 5382; instance of it among gold workers in California, with diet of salt provisions, rum, and coffee, yet no vegetables, 5362; outbreak among Captain Cook's crew in a warm latitude, but a bad season, 5362; outbreak during Irish famine, due to deprivation of vegetable food, promoted by famine, 5365.

Dr. Buzzard—

Amongst railway excavators, with large quantities of animal food, 5423; in Cumberland, with quantities of turnips, 5423; in Exeter, with absence of potato from diet, 5423; in Ireland, with diet of bread, tea and coffee, fish or grains, 5423; in the Crimea, in the French army, in 1855, with fresh meat twice, then five times a week, rice and dried vegetables; improvement with dandelion; recurrence with failure of supply, 5424; in the Sardinian army, 1855, checked by vegetables, 5424; in the Turkish army, in Mingrelia, 1855-6, with diet of biscuits, rice, and yah; recovery on oranges and lemons, 5424; in the Turkish army, in the Crimea, in 1855, with biscuits, rice and fresh meat twice or thrice a week, and when in good spirits, 5425; occurrence of frost-bite in troops in the Caucasus, particularly in scorbutic men, 5495-6; conditions under which they occurred, 5497; in London amongst the poor, 5425; but on a starvation diet, 5426; in many of these instances, the dietary was quantitatively sufficient, 5428; instances in Australian life with much exercise and open air, but with a diet of meat, tea, and damper, 5445.

Mr. Leach—

Instance of scurvy occurring, owing to want of good animal food, in the "Royal Sovereign," 5544.

Vice-Admiral Ommanney—

Symptoms of scurvy in the White Sea Squadron, want of food other than ship's provisions, severe weather and confinement to ships, 5902-3; scurvy amongst the Irish during the famine, 5903-6; occurrence of scurvy in prisons, 5850.

Captain Feilden—

None when with General Beauregard, 6084.

SCURVY. 6. In other than Arctic Expeditions, *continued*—Rear-Admiral Pullen—

Had never met with scurvy, 6164-5; has travelled in Australia on meat diet without it, 6166; unknown at the Hudson Bay stations, 6144, 6197; immunity due to hard work, good air, and fresh provisions, 6199.

Mr. J. Organ—

Saw a case of scurvy in a merchant ship, 6814-15.

Dr. Barnes—

Outbreak in Scotland, 1846-47, when potato crop failed, and on a diet of bread, coffee without milk, and salt fish and fresh meat, 7026-7; no vegetables, 7026-7; food taken from tommy shops of contractors, 7027; its existence among crusaders, 7029; formerly in Holland when badly drained, and diet salt pork and beef, 7030; cessation since the production of vegetables, 7030; none on board ship in the navy in the Crimea, but it existed on shore, 7031; from what ports the greatest number of cases were sent to the "Dreadnought," 7080; Ham-burgh ships especially, 7080; instance of an attack in the "Gorgon" in the River Plate with little fresh meat, and no vegetables or lime juice; recovery on oranges and fresh meat; immunity of a French ship under similar conditions, but with wine and beer, 7097, 7127-9; one death, 7127; attack at Ottawa among lumber men in absence of vegetables, where nitrate of potash was used in salting meat, 7163.

Alexander Gray—

In the whalers and American vessels, 7173-81, 7193-4; five deaths from the "Alibi," 7178, 7193; treatment by the captain on vegetables, lime juice and fresh meat, no doctor wintering on board, 7176-88; thousands of chances more of it in whalers than in the navy, 7203; has not seen scurvy among the Esquimaux, 7199; immunity of officers of whalers, 7570; due to taking more exercise, 7571-2; not to diet, which is much the same as the men's, 7573; cause of scurvy in whalers want of exercise in the winter, 7195; it would come out after return and diet of vegetables, 7606-7; what the symptoms were, not the same as in the recent expedition, 7196-8, 7579.

Dr. Munro—

Instances of scurvy at the Cape—

Occurring largely among the troops during the Kaffir campaign, 1846 to 1848, 8515-26; on diet of abundant fresh meat, biscuits, coffee, and rice, 8516; was due to sameness of diet, 8515-16; no fresh vegetables, not being cultivated for sale, 8516-7; exemption of the 91st Highlanders being less exposed, and having potatoes, pumpkins, and onions, 8518-21; the leaf of the spekboom used with advantage in treatment of cases, believes it contains malic acid, 8528-35.

Scurvy in the Crimea—

His regiment (93rd Highlanders) had had diarrhoea in Bulgaria, it was below par on landing in the Crimea, slept in open air, diet being salt meat, biscuit, coffee, and rum, diarrhoea increased, although tents were sent, in December scorbutic dysentery set in, and three deaths a-day occurred, 8537; recovery on the vegetable diet sent out, preserved and pressed vegetables, 8538-42; and health continued, better vegetables being always supplied, 8551-54; complication of the disease with dysentery and fever, 8543, 8588; what the symptoms were that were discovered on post-mortem examination, 8543-7; the cholera they suffered from was an incipient form of scurvy, 8587.

In India with 93rd Highlanders in 1863—

Good health during Mutiny campaign; epidemic of cholera and fever afterwards whilst stationed at Peshawur; recovery of men on march to Sealcote, rations they received, fresh meat, bread, potatoes, onions, and rice, rum or beer, &c., 8555; exposed to heat and change of temperature and cholera, 8646; never without vegetables, 8556; oranges, lemons, and other fruit to be purchased, 8556, 8605; and were bought, 8697; occurrence of three cases of scurvy in the hot weather, 8557, 8602-4, 8658; in spite of diet of fresh meat, fresh vegetables, and beer, 8557-9; they had certainly eaten the vegetables, 8562, 8659-63; potatoes were fresh, and did not run short, except accidentally, 8565-6; and had every reason to suppose they were eaten, 8696; had suffered from intermittent fever, which would affect the appetite, 8560-2; and suffered from scurvy together with it, 8663-4; their symptoms, 8563; their treatment, 8564; 8655; lime juice not alone trusted to, 8570; beer, wine, and vegetables given, 8570; quinine given to the whole regiment, 8655-7; to what extent the fever may have prevented assimilation of vegetable food, 8635-6; the appearance of the men not one of want of nutrition, 8641-2; fever not always apparent, sometimes rations eaten and work done, 8661; his attention was specially drawn to these three cases, 8698.

Instance of attack of a battery of Horse Artillery in 1868 (after suffering from malarious influence in the Peshawur Valley) at Umbala, 8567; the heat there very oppressive, 8646; a double ration of vegetables given, 8567; recovery at Umbala on ordinary ration, beer and rum,

SCURVY. 6. In other than Arctic Expeditions, *continued*—

8568; would get potatoes and onions, 8605; and buy oranges and pumpkins and limes everywhere, 8605; possibility of the intermittent fever from which the men suffered having interfered with assimilation of food, 8638-41; how the temperature was at the time, 8643-5; reasons for knowing that all the full or extra allowance of vegetables had been issued, 8648-52.

Instance on board ship in the 55th Regiment going out to India of a man who had taken lime juice, 8596-8; does not place reliance on it, not having been able to substantiate it, 8665-73.

Dr. Rae—

Instances in a Hudson's Bay ship, in 1833, of which he was surgeon, and which wintered at Charlton Island, 8748; diet of salt pork and beef, salt goose, biscuit and flour, little fresh food, lime juice or rum, spruce beer made, 8748, 8765; no vegetables, except frozen potatoes, for the sick, 8766, 8771; fifteen or sixteen cases out of thirty persons, their symptoms, death of captain and first mate, recovery of the rest on cranberries and vetch, after exhaustion of lime juice, 8748-52; the men of the Hudson's Bay service very little affected, the crew and passengers chiefly attacked, 8749-50; but little lime juice given, and that not regularly, 8768-71.

In the Hudson's Bay service—

Scurvy only appears at York Factory, is owing to diet being chiefly salt meat, 8794-8800, 8815-6; preserved potato and cranberries issued when there is not enough fresh meat, 8796-7; the scurvy generally appeared in absence of fresh venison, 8816; none occurred in his sledge journeys, 8883.

7. In late Expedition, whether taking Lime Juice sledging would have prevented the outbreak—

Sir G. Nares—

Has seen scurvy give way under it, 44, 138; taking it might have delayed the outbreak, 9377; lime juice was taken by Sir J. Ross's party without preventing it, 166.

Captain Stephenson—

Possibly attributable to absence, 491.

Captain Markham—

A daily allowance sledging would not have averted or delayed it, 749; cases which occurred whilst taking it, 750-52.

Lieutenant May—

Would not have averted it from extended parties, 829.

Commander Beaumont—

Disappointment at want of anticipated effect, 990; whether it would have averted or delayed it, 1000.

Dr. Colan—

If sent sledging it would have been delayed or modified, 2166-8; not averted, 2167; absence of it may account for scurvy, 2012-14.

Dr. Moss—

Disease would have been less virulent had it been taken, 2472; might have been averted, but probably not, 2482, 2483.

Dr. Ninnis—

Its presence sledging would have modified, not prevented it, 2595, 2734-5.

Dr. Coppinger—

Modification of the circumstances of the sledge journeys if it had been carried, and consequently of the disease, 2978.

Captain Hamilton—

It would have much lessened it, 3068, 3083.

Admiral Richards—

Does not believe its absence caused the recent breakdown of sledge crews, 3228.

Sir L. M'Clintock—

It would not have kept it off, 3324.

Dr. Toms—

Absence of it sledging would produce scurvy, 3752; taking it would have averted scurvy in most instances, 3759-60.

Dr. Scott—

Would not have kept it off, 3947; since it broke out soon after leaving off lime juice, 3954; would keep off scurvy unless work were too severe, as in recent expedition, 3978.

Mr. Ede—

Would have been modified if taken and previously drunk on board, 4091.

Dr. Piers—

Would have been delayed if taken, 4687; is not prepared to say it would have been so sledging, 4688.

Dr. Macdonald—

Would have been averted if it had been given to sledging parties, 4954.

Dr. De Chaumont—

Would have gone a long way towards warding it off, 5111-13; not entirely warded it off, 5112.

Dr. Pavy—

A daily allowance would have delayed the outbreak of scurvy, 5234; but not averted it, unless a larger ration had been given, 5235; would recommend two or three ounces, if practicable, 5236.

Mr. Busk—

The invasion of scurvy would inevitably have taken place

SCURVY. 7. In late Expedition, &c., *continued*—

even had lime juice been taken, 5284; but at the end of sixty or seventy days, instead of so soon, 5284-5.

Mr. Leach—

If taken sledging, the outbreak would not have been what it was, 5596; it was due to its absence, 5602-6.

Dr. Dickson—

Would have delayed and mitigated the scurvy, 5727-8; but not averted it altogether, as it is only a substitute, 5728.

Dr. Barnes—

Would have been postponed for a time, not prevented, 7073-5; its absence hastened the outbreak, 7110, 7147-8.

Dr. Rae—

It might have delayed or mitigated the outbreak in the late expedition, 8886-7.

Sir A. Armstrong—

It would have assisted assimilation of food, 9008-9; and thus prevented the debility, 9093; and have prevented scurvy and other affections, 9090, 9019-20.

SCURVY-GRASS. [*See Sorrel.*]

SELF, JAMES, A.B., of "Alert"—

Lieutenant May—

Immunity from scurvy owing to medical comforts when ill during the winter, 836.

SHEPHERD, JAMES, Cooper of "Discovery" (sometimes described as Sheppard)—

Captain Stephenson—

Shepherd (the first case of scurvy) had taken exercise outside, 368, 412; had not been travelling, or subjected to violent exertion, 369-70; duties lay between decks, 371; he preferred salt meat to other meat, 414; during treatment, consumed vegetables, 419; was employed in issue of provisions and as cooper, 348; character good when on board, 351; above the prescribed age, 352-3; was a troublesome patient, 354; health had been good previously, 355; had been a hard drinker formerly, 356.

Dr. Ninnis—

His case, 2513-30; pronounced medically unfit in England, 2514-15; assisted the ship's steward, 2517; had formerly lived a free life, was steady on board, 2518-19; health good at first, strong on journey, 2519-20; doubt as to his eating preserved meat, 2522-7; he took his vegetables, 2527; must have taken lime juice, 2528-30.

Dr. Coppinger—

He was ill in winter, 2834-5; had not always eaten his vegetables, 2842, 2850; but generally had, disease not to be attributed to the omission, 2843-7; moral character very satisfactory, 2849; his recovery after mild weather, when he took exercise, 2974.

Alexander Gray—

His duties, 7402-3, 7404-6; scurvy began before Christmas, 7410-11; not a strong man, 7413; may have drunk too much in his early days, 7414-15; possibly on board, 7417; no command over spirits on board, 7418; the date of ill health, 7419-21; his symptoms, 7424-28.

Mr. Emmerson—

He mixed the lime juice, 8161; and took his fair quantity regularly, 8162, 8260; his illness, 8155-60, 8259; soon after Christmas, 8242-3; the nature of the illness not allowed to be known, 8155-9; he was captain of the hold and ship's cooper, 8240; not strong sledging in the autumn, 8245-6; had drunk much malt liquor in his time, not on board, 8248-9, 8254-5; used to work on the ice, 8252; had not a specially good appetite, 8256-8; particular about food, and would not eat it always, 8261-2; did not eat when ill, 8263; ate vegetables, especially onions, 8264-5.

William Jenkins—

He was delicate, 8440, 8444; not a good appetite, 8441-7; what he ate, 8443; did not eat salt meat, 8445; was very ill, 8451.

SHIPS' EQUIPMENT, AND ARRANGEMENTS OF. [*See Equipment and Ventilation.*]

SHIRLEY, J., Stoker of "Alert."

Captain Markham—

Exhaustion in autumn sledging, 579; attack of scurvy in spring, 577-84.

Thomas Rawlins—

His symptoms, 7772-6; not weak before pains in knees, 7774-5.

SIMMONS, JOHN, A.B., of "Alert."

Dr. Colan—

Scurvy in the case of John Simmons, who had been dog-sledging, 1858-60.

Sir A. Armstrong—

Remarks on his case, 9252.

SICK-ROOM. [*See Ventilation.*]SLEDGING AND SLEDGES. [*See also Equipment, Appetite, Thirst, Sleep.*]

Subheads 1. General.

2. Recent Expeditions.

3. Former Expeditions.

4. Dogs and Dog-Sledging.

5. Weights Sledging.

6. Journeys other than Sledging.

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Dog-sledge work as severe as dragging, 151.

Lieutenant May—

He had a dog-sledge, 790; how far a dog-sledge requires less exertion on the part of the men, 804; dogs stop in rough ground, 804.

Commander Aldrich—

All dog-sledges in his autumn journeys, 1312; the only hard work was on return, 1256; the snow being too deep for the dogs, 1318; harassing work from unequal pace, 1318.

Lieutenant Egerton—

In inland journey dogs used, 1581; Esquimaux drove the dogs, 1582; driving the sledge hard work, 1584.

Dr. Moss—

A dog sledge taken in the autumn, 2191.

Sir L. McClintock—

Dogs were attacked with fits, 3327; two dogs equal to a man, 3407.

Captain Hobson—

Work in a dog-sledge quite as great, 3461; same necessity for dragging, 3462; difficulty to get dogs to work in rough ice, 3463; their refusal to move till the sledge is started, 3463; assistance derived from them in dragging part of the weight, 3462-5; dogs used to drag each a hundred pounds in sledging from "Fox," could not have done the work without them, 3463-5.

Dr. Toms—

The dogs did nothing, 3683.

Captain A. Young—

Had a dog-sledge in McClintock Channel, but found dogs of little use owing to hummocks and soft snow, 3781-5.

Captain Feilden—

Absent for about fifty days, but in short journeys, 5921, 5936, 5981-2; always had dog-sledges, 5983; hard work

SLEDGING AND SLEDGES. 4. Dogs and Dog-Sledges, *continued*—

in July, dragging through slush, 5943-5; with the dog-sledges only one or two men went, 6045.

Alexander Gray—

Dogs were used by whalers, 7244.

Dr. Rae—

Took dogs on two of his expeditions, 8802; they were useful with smooth ice, 8803; but are difficult to get on in bad ice, 8803-4; good condition of dogs on journey to Minnesota, 8746.

5. Weights.

Sir G. Nares—

Two hundred pounds enough for a sledge but greater weights had been dragged on former occasions: 170 lbs. only possible with journeys later in the season, 9303; weights have varied from 200 lbs. to 250 lbs. at starting, 9340; the weight of 405 lbs. per man never dragged at any one time, although transported on the northern expedition, 9322-3; 240 lbs. the heaviest weight dragged, 9322.

Captain Markham—

What weights they dragged, 570; increase after outbreak of scurvy, 571; greater in spring than autumn, 710.

Commander Beaumont—

Weight about 150 lbs. per man, 847.

Commander Aldrich—

Weight in spring, 242 lbs. per man, 1260; weights in the spring journey, 1329; double manning till 30th April, thus reducing weights to 125 lbs. per man, 1329; subsequent weights, 1329; difficulty in computing weights where sick men are dragging, 1353.

Commander Parr—

Weights in second autumn journey, 200 lbs., 1416.

Admiral Richards—

Great distances cannot be travelled with more than 220 lbs. per man, 3127.

Sir L. McClintock—

The weights that can be dragged, 240 lbs. with the largest sledge, 3406; but this is modified by nature of ice, 3406.

Captain Hobson—

When sledging from "Rattlesnake," men used to be weighted to drag 200 lbs., the dogs 100 lbs., 3463-5.

Captain A. Young—

Weights in his first journey, 3774.

Mr. Ede—

Men dragged 187 lbs. at starting, but weight diminished, 4135-6.

Commander Cameron—

Account of the weights and mode of carrying in his journey across Africa, average 50 lbs., 4761-3.

Vice-Admiral Ommanney—

Weights carried sledging from "Assistance," 5860; diminished with progress of parties, 5861-9; weights in his sledge division ranged from 240 lbs. to 190 lbs., 5867-8; no increase from illness, 5870-71.

Rear-Admiral Pullen—

193½ lbs. per man in his journeys, 6228.

Mr. Bayley—

Weight on first journey, 240 lbs. and a boat, 6402.

Thomas Rawlings—

The weights 200 lbs. in autumn, 240 lbs. in spring, 7646; sledges advanced one at a time, 7655-7, 7827; no man dragged more than 240 lbs. at a time, 7771; weights did not increase after men fell ill, because the boats and provisions were left behind, 7786.

Color-Sergeant Wood—

240 lbs. the weight dragged, 7999, 8063; gradually lessened but was again filled up from supporting sledge, 8004, 8009, 8065.

Mr. Emmerson—

Weight not over 200 lbs. a man, 8110; weights about 240 lbs., 8115-20.

Dr. Rae—

Weight for a dog 100 lbs., for a man 150 lbs., an Indian woman with snow shoes known to haul over 200 lbs. of fresh meat at ten or twelve miles a day, 8731; he took 40 lbs. constant weight, 8841; constant weights of recent expedition too large, 8841, 8882.

Sir A. Armstrong—

Weights carried from "Investigator," 9205; under 200 lbs. a man, 9228; only 170 lbs. dragged in sledges, 9147, 9205; the weights taken in late expedition excessive, especially with the work, 9017, 9146, 9147; not more than forty or fifty days, or 200 lbs. a man, equipment should be taken, 9147, 9282.

6. Journeys other than Sledging—

Commander Beaumont—

From Thank-God Harbour across Hall Basin, 915-19; condition of the ice and the difficulties encountered, 919; arduous nature of the duty, 920.

Commander Cameron—

Before the outbreak of scurvy, in his journey across Africa, his marches were not hard, but they had been so, 4736; very severe work and little to eat before reaching Bihe, 4759; the nature of work, no halts, and ten or eleven hours' march, 4760.

SLEDGING AND SLEDGES. 6. Journeys other than

Sledging, *continued*—

Rear-Admiral Pullen—

Boat journeys, 6086; boat journey from "Plover" up the Mackenzie River to Fort Simpson, in 1849, 6087; from Fort Simpson to Cape Bathurst and back in 1850, 6087; return to England, 1851, 6087; had fourteen men and two five-oared whale boats, 6089; all English sailors of the "Plover," 6184-5; experienced heavy gales, obliged to throw food overboard, 6097; his party in winter of 1849-50 distributed between Forts Simpson and Macpherson and the Great Slave Lake, 6097, 6119, 6127-32; left Fort Simpson 11th July, 1850, and returned to it 5th October, 6114, 6169, 6177; what men he had, 6171; some at the Great Bear Lake in Franklin's old fort, which they repaired, 6119; a hunter and a fisherman being with them, 6119; they could not find provisions without dividing the parties, 6132; the arrangements were made by Dr. Rae, 6132.

Dr. Rae's Journeys, see Subhead 3.

SLEEP. [*For effect of Spirits in producing Sleep, see Spirits.*]

Captain Markham—

But little sleep sledging till temperature rose, 677-9.

Lieutenant Giffard—

Cold prevented sleep sledging, 1218; but men slept well as a rule, 1231.

Captain Hamilton—

Three or four hours given by rum, the rest of the time spent dozing or waking, 3009.

Admiral Richards—

Men at first cannot sleep sledging, 3223-4; men slept fairly, 3224.

Mr. Bayley and J. Organ—

On board "Assistance" men got enough and refreshing sleep, 6457-9, 6772-4.

SMITH, THOMAS, Private R.M., of "Alert"—

Dr. Colan—

Scurvy after several short journeys, 1915-21.

SNOW—

Captain Markham—

Men warned against eating snow, 686; what depth of snow was, 676.

Commander Beaumont—

Description of snow, the difficulty in walking in it (over four feet thick), 962; over the knees and too heavy to push through, 996, 881; not much eaten by men, 973.

Lieutenant Rawson—

In autumn up to knees always, in spring at times only, 1169.

Commander Aldrich—

Description in autumn and spring, 1380; difficulty in walking, caused by formation of crust, 1380; was up to the knees, 1380.

Commander Parr—

Snow deep and soft in spring, but better than in autumn, 1423; its depth, 1523; up to the knees or waist amongst the hummocks in autumn, 1524.

Lieutenant Egerton—

Difficulty in inland journey owing to deep snow, 1546, 1550; dogs could not get through it, 1551.

Admiral Richards—

Two or three feet of snow, hard enough to bear the sledge, 3094-5; disposition to eat snow when suffering from thirst, 3222.

Sir L. M'Clintock—

Seldom more than a foot deep, 3244; soft after May, 3245.

Dr. Toms—

No bad results from eating snow, 3717-18; felt refreshed after it, 3720; eating ice not equally safe, abstraction of heat greater, 3721-2.

Captain Hobson—

Not much snow eaten sledging from "Fox," 3514; it increased thirst, 3515; difficulty in estimating depth and character of snow, 3410.

Captain A. Young—

Snow on his journeys four feet thick, 3763-4; quite loose between the hummocks, 3765.

Dr. Scott—

But little in his sledging, it was soft and sludgy, 4032; deep in the ravines, 4036.

Mr. Ede—

The snow in autumn soft, in spring hard, 4234; not deep on the floe, but was in ravines, 4235; snow soft after a fresh fall, sank quite a foot in it, 4261.

Dr. Lyall—

The snow generally firm enough to bear the sledges, 4423; after it began to melt the men would sink up to their knees where it had drifted, 4423-4.

Captain Feilden—

Advantage of plan of Esquimaux in eating snow, 6065-7.

Rear-Admiral Pullen—

Soft snow where the hummocks were piled up in his journeys, 6238.

Mr. Bayley—

Very heavy work over Melville Island, 6506; sank a foot

SNOW, *continued*—

or more in snow, 6508; runners of sledges would sink in it occasionally, 6510; character of the snow on respective journeys, 6504-10.

Color-Sergeant Wood—

Eating snow not allowed, 7984.

SNOW-BLINDNESS—

Sir G. Nares—

Arrangements for preventing, 242; their success in doing so, 242; goggles supplied useless for the purpose, 250.

Lieutenant Rawson—

Attack of snow-blindness, 1152.

Lieutenant Giffard—

A few slight cases of, 1219.

Commander Parr—

Suffered from snow-blindness, 1512; symptoms of this, 1513; attack of, 1513-14; recovered before it was necessary to make a road, 1515.

Dr. Moss—

Occurrence of cases, the symptoms, 2405-6; the treatment, 2408.

Vice-Admiral Ommanney—

Some severe snow-blindness sledging from "Assistance," 5891; arose from want of precautions, 5892; inutility of crape veils and advantage of goggles, 5891.

SNOW HOUSES—

Dr. Rae—

During journey in 1845 built snow houses and took only blankets, 8722-4; preference for snow house over tents as warmer, healthier, and preventing the bedding getting frozen, and saving dragging weights, 8841-2; method of making them, 8841; time taken to do so, 8842; no moisture in their snow huts, 8843; snow huts of the Esquimaux, method of building them and arrangements in them, 8844-5; they object to glazing their huts, or using ice in their construction, as ice is a better conductor of caloric than snow, 8844-5; no warming except an oil-lamp, 8846; what the cubic space is for six or eight persons, 8847-8; the air not impure, the snow being porous enough to admit air through without draft, 8550; enough light comes through the walls to see to read and write, 8851.

SNOW SHOES.

Commander Beaumont—

Suggestion to take them sledging, 954; their use in snow as heavy as was encountered, 997; difficulty in dragging in them, 998; what kind he would use, 998.

Lieutenant Rawson—

Used snow shoes once, could not drag over rough ice with them on, 1170.

Commander Pelham Aldrich—

Canadian snow shoes good, 1407; they would have been useful for the officer, but not for dragging, 1406.

Commander Parr—

Snow shoes would have been an advantage, 1525.

Lieutenant Egerton—

The ordinary Canadian snow shoes would have been of great service inland, 1610-12.

Dr. Moss—

Useful to the officers exploring or leading, 2491; recommends Western North American, 2492.

Sir L. M'Clintock—

Would never have been an advantage, 3254.

Dr. Rae—

An account of different sorts, 8754; advantage of taking them, 8755; they would have rendered the work in the western and eastern journeys of the late expedition easier, 8879-80.

SORREL AND SCURVY-GRASS—

Sir G. Nares—

Scurvy-grass not obtained till after outbreak of scurvy, 46.

Lieutenant Rawson—

Found no scurvy-grass on journeys, found sorrel later on, 1107, 1156.

Dr. Colan—

A little obtained, 2153-5; found in patches, 2157.

Dr. Copping—

A large quantity of kidney-sorrel at Polaris Bay, 2974; advantage of kidney-sorrel in treatment of scurvy cases at Polaris Bay, 2974-6.

Commander Aldrich, Dr. Colan, Dr. Moss, Sir L. M'Clintock,

Admiral Richards, Dr. Scott, Dr. Toms, Dr. Lyall, Mr.

Bayley, Captain A. Young, Captain Hobson—

None obtained, 1393, 2152, 2438, 3305, 3152, 3233, 3928, 4033, 3622, 3743, 4318, 6383, 3808, 3439.

Captain Hamilton—

But little obtained by "Resolute," 3022.

Mr. Ede—

Found some at Carey Islands, 4109.

Dr. Piers—

Much sorrel but little scurvy-grass obtained in "Investigator," 4541; what they got, recovery of scorbutic cases under it, 4619-26; its taste an agreeable sub-acid, 4620; it was obtained only in 1852, 4646.

Vice-Admiral Ommanney, "Assistance"—

A considerable quantity of sorrel found on the way home, 5775-6.

SORREL AND SCURVY-GRASS, *continued*—

Captain Feilden, "Alert"—

Got mountain sorrel, but little scurvy-grass, 6072.

Mr. Bayley—

Piped hands to grass occasionally 6299.

SPEKBOOM—

Dr. Munro—

Account of spekboom, 8622-8631; used at the Cape to make tarts, 8623; its effects equal to lime juice, 8626-7.

SPIRITS. [*Effects of Wine and Spirits as antiscorbutic. See also Diet and Scurvy. The remarks, unless otherwise specified, generally apply to Sledging.*]

Subheads 1. General.

2. Rum.

Evidence.

1. General—

Sir J. Nares—

Issue of spirits, 107-8, 109-12; rum the usual form of spirits, 112; what the ration was, 111.

Captain Stephenson—

Spirits should be furnished to arctic travellers, 300.

Captain Markham—

Alcohol in moderation necessary at end of the day, 664; it was given in sleeping bags at night, 669.

Commander Beaumont—

Men did not care much about spirits except in tea, 993.

Lieutenant Giffard—

Advocacy of use of spirits, 1229; after supper, 1230; would not substitute lime juice for spirits, 1234.

Commander Aldrich—

Should be taken sledging, 1403.

Dr. Colan—

Spirits increase vigour temporarily under hard work, 2089.

Dr. Ninnis—

The quantity given in "Discovery" not enough to affect any constitution, 2693; grog conduces to sleep by producing a glow, 2731.

Dr. Coppinger—

Recommends spirits to be taken sledging as medical comforts only, 2933.

Dr. Pavy—

Alcohol of alimentary value as well as of narcotic stimulant powers, 5196-99; it increases the action of the heart, 5200; and the calibre of the vessels, 5201; the increased heat thus developed, is counteracted by its escape, owing to the warm blood being carried to the surface, 5202; diminishes capacity for work, but is advantageous for nervous system when exhausted, and predisposes to sleep, 5204-5; it diminishes the bad effects of over exhaustion and promotes cheerfulness, 5206-7; one ounce enough to produce its effects, 5208.

Mr. Busk—

Should not be given as regular rations when sledging, alcohol consuming the strength and indisposing men to take food, 5249.

Dr. Guy—

Alcohol the finest narcotic possible, instance of its use in typhoid fever, 5415; and should be taken sledging, to be used with discretion, to induce sleep, 5415.

Rear-Admiral Pullen—

He had a little in Hudson's Bay the second year, but not enough for the men, 6160.

J. Organ—

Spirits have saved many a man, 6777; advantage over tea in not wanting preparation, 6777; and by acting as a stimulant, and enabling the men to do a little more work, 6778-82; work well done while grog lasts, 6782.

Dr. Barnes—

Objection to alcohol, except in very small quantities, its sudden abstraction not injurious, 7112.

Captain Hamilton—

In "Assistance" and "Resolute," wine was supplied to the sick, 3035.

(Remarks by Dr. Rae, see Subhead 2.)

2. Rum—

Sir G. Nares—

Ration doubled in winter, 111; stopped when outbreak of scurvy took place, 182-3; hence it was not all consumed, 183; allowance of tea increased if rum decreased, 192, 197-8; formerly taken for luncheon, 193; was weary after rum, 196; tea only in the evening sledging with rum, 194; would not substitute lime juice for it, 200.

Captain Stephenson—

Allowance of, doubled during winter, 293-5; reasons for this, 311; half-gill enough for most men, 296; only taken before sleep sledging, 297; does not know if it added to physical endurance, 298; was a luxury in cold weather, 298-9; would not give up rum to carry lime juice, 494; necessary and acceptable at the end of the day, 503; if obliged, would give it up rather than lime juice, 504; all the rum consumed, but some as fuel, 360-61.

Captain Markham—

Felt better after he took to drinking his rum, 667, 693-7.

Lieutenant May—

Advantage after supper, 839.

SPIRITS. 2. Rum, *continued*—

Lieutenant Rawson—

Advantage at night when sledging, 1158; was taken in tea, 1166; makes men sleep better, and cheers them, 1159.

Commander Aldrich—

Advantage at night, 1401; how taken, 1401; only tried it once at luncheon, and men suffered inconvenience, 1401.

Commander Parr—

Rum is comforting after supper, and helps sleep, 1520; would not abandon rum, 1465, 1519.

Dr. Colan—

Advantage of, in producing cheerfulness, 2018-19; sledging used going to bed, 1794; was found beneficial then, 1792-3, 2017; ought not to be dispensed with, 2017.

Dr. Moss—

Objection to rum, 2422.

Dr. Ninnis—

Taken for luncheon when he sledged, 2713; men did not work better after it than after an ordinary halt, 2714.

Dr. Coppinger—

Rum, sledging, not a necessity, 2917-8.

Captain Hamilton—

A gill a-day, issued twice a-day, 3008; advantage at lunch in shorter halt, 3009; advantage of, at night, as conducive to sleep and preventing cold if wet, 3009; warmth produced by mixing rum and tea, which was due to the mixture, not to either alone, 3084-7; always mixed tea with rum, 3085.

Admiral Richards—

Used to be taken half at lunch, half at night, 3120; it was very acceptable to the men, 3121; a gill given, 3119; men worked better before than after it, 3122; advantage of rum at night in enabling men to change their gear and inducing sleep, 3176.

Captain Hobson—

Should be taken sledging, one gill a-day, 3548; men worked better after luncheon on it, 3549.

Dr. Toms—

Advantageous in great fatigue, 3745; should be given at night or to make spurts, 3746-7; but at luncheon tends to debility, 3748.

Captain Allen Young—

Attaches secondary value to rum, prefers tea, 3878-9; it is a necessity on board, 3880; would take both tea and rum sledging, 3804-5; excluding rum, if one must be excluded, 3806.

Mr. Ede (Sledging)—

Preference for tea over rum, 4099-4100; the reaction from excitement of rum produces too much depression, 4101; a little should be used as a fillip before the evening meal, 4102-3.

Dr. Lyall (Sledging)—

Both rum and tea good in their way, 4312; rum was useful, 4312; used in antarctic expedition, 4412; had a cheering effect at the end of the march, 4412; the men being too chilled to take off their boots till they drank it, 4412; they had it for luncheon and supper, 4413; after luncheon they worked better at first, but the effect soon worked off, 4414; but the men are more tired the second half of the day, 4414; prefers rum at night, tea for mid-day meal, 4413, 4415.

Dr. Piers—

In "Investigator" men did not latterly care so much for their rum, 4685; it might be dispensed with in arctic service, 4686.

Dr. Macdonald—

It induces cheerfulness, but is regarded a disadvantage in the arctics, 4864; half-a-gill would not injure a healthy man, 4864; men would not work so well after it, 4865.

Dr. De Chaumont—

Proved to be bad to work on, 5102; would not exclude it sledging, but would put it last in the diet, 5103; might be advantageous if distressed in the evening, 5117; the men having time to rest before subsequent exertion, 5118; useful as a ration at night in Ashantee, 5118.

Dr. Dickson—

Desirable, but lime juice of greater advantage, 5684; would sacrifice rum rather than tea, but considers it desirable, as producing cheerfulness, 5722.

Vice-Admiral Ommaney—

It should not be reduced when sledging, 5910; an extra issue advantageous, 5910; men worked better after it, 5912; would take it, it was liked, and given sledging from "Assistance" for luncheon, 5771-3, 5911-13.

(The following relate to Sledging, except Dr. Rae)—

Captain Feilden—

Rum, if taken, most useful before going to the bags, 5963; disadvantageous when working, 5961.

Rear-Admiral Pullen—

His men took their rum in the day time, and smoked at night in their bags, and did not want spirits, 6243.

Mr. Bayley—

Rum was taken for lunch and liked, 6391-5; was beneficial, 6394; men worked well after it, 6499; advantage of giving it on camping before tenting again, 6528.

J. Organ—

Advantage of it at end of the day, when tired or cold.

SPIRITS. 2. Rum, *continued*—

in keeping up a warmth after ceasing dragging, 6767, 6777; took it twice a-day, 6769; before tenting, 6770; tea after supper, 6770.

Mr. Murray—

Preference for rum at luncheon, 6922; not bad to work on, 6923; in his expeditions they had it for luncheon, 7016.

Alexander Gray—

Issued at night, was popular, would have been liked better at lunch, 7216-17.

Thomas Rawlings—

Taken at night when sledging, 7664; and liked then, 7759-63; assists going to sleep, 7664, 7759-63.

Color-Sergeant Wood—

Issued at night sledging, 7916; advantage of it in giving a glow and producing sleep, 7916-17.

Mr. Emmerson—

Objects to it when sledging, and prefers tea, 8177; useful by giving a glow and inducing sleep, 8177-79; specially if taken in tea; 8179.

William Jenkins—

Good at night on turning in, 8420.

Dr. Rae—

Ration of spirits not given in Hudson's Bay Territory, 8808; even to officers, owing to desire of keeping it from the Indians, 8809; men, even if fond of spirits, would not take it before the work was done, 8810; bad effect of rum in a cold climate, 8836; no spirits taken sledging, except for fuel, 8807; and as a medicine, or to give occasionally, 8873-4; it was popular when given, 8874; it is not necessary in sledging parties, 8875.

Sir A. Armstrong—

Might be dispensed with, but adds to the comfort of men after work is over, 9011; they do not work so well on it, 9012.

STUCKBERRY, THOMAS, Petty Officer of "Alert"—

Dr. Colan—

Condition after journeys with Lieutenant Giffard and a relief party, 1970-80; he became ill after being on board a few days, 1975; probably had symptoms while traveling, 1978.

SUN, ABSENCE OF. [See *Darkness*.]

SYLVESTER STOVE.

Sir G. Nares—

Description of stove, disadvantages of it, 221-2; it cannot be used in steamers without great loss of fuel, 9303.

Captain Hamilton—

Advantage of it, supplied to former expeditions, 3071-3.

Dr. Toms—

Method of heating "North Star" by, 3555-60; heating on both "North Star" and "Pioneer" was with this stove, 3643-4; it was a heating, not a ventilating apparatus, 3644-5.

Admiral Richards—

In "Assistance" warmth of lower deck dependent on this stove, 3211; its consumption of coal, 3212; did not promote ventilation, 3213-14; communication of pipes with it, 3214; they did not communicate with open air, 3217; no heat from it in the captain's cabin, 3217.

Sir L. M'Clintock—

Used in "Fox," it had no effect on the lower deck ventilation, 3384; the warming of "Intrepid" by stoves proved better than it, 3384.

Dr. Scott—

"Intrepid" warmed by Sylvester stove, 3891; description of it, 3892-5; it did not warm his cabin, 3896-7; "Resolute" had a Sylvester stove with tubing, 3908-9; it was more for heating than ventilation, 4019.

Mr. Ede—

"Assistance" warmed by Sylvester stove, 4050; passing through his cabin, 4051; whether the hot air escaped and was renewed by fresh air, 4052-4; the moisture was driven off by the stove, 4237.

Dr. Lyall—

In "Assistance" 1852-54, where the stove opened, 4277, 4279-80; preference for it with sufficient coal, requiring a good deal, 4326-7.

Dr. Piers—

Had one in "Investigator," 4490-91; no opening from the stove into his cabin, 4498; not fresh hot air, 4500; believes it did not admit fresh air, 4664; but warmed the air in the ship, 4665.

Dr. Macdonald—

What it is, 4828.

Vice-Admiral Ommanney—

Description of one in "Assistance," 5731; what apertures it had, 5733-5; officers complained of too much hot air from it, 5736; its warm air flues did not extend to the captain's cabin, 5736; air from Sylvester stove was heated on admission, 5794.

Rear-Admiral Pullen—

Used in "North Star," 6217.

Mr. Bayley—

Did not come before the fore part of the fore hatchway in the "Assistance," 6513.

J. Organ—

One used in "Enterprise" in 1848-49, 6535-6.

SYLVESTER STOVE, *continued*—

Mr. Murray—

Had one in "Enterprise" in 1850-55, 6947; which warmed the ship well, 6948; better ventilated than "Investigator," 6949.

Sir A. Armstrong—

H.M.S. "Investigator" was warmed by it, 8940; account of the stove, tubes communicating with cabins, dissemination of hot air through the ship, 8940-41; it communicated with the outer air, 8942-3, 9070; not directly, 9071; preference for it over mode of ventilation of recent arctic ships, 8945; provided there is a good supply of coal and it can be kept alight, 8945-6.

SYMONDS, ROBERT, A.B. of "Alert"—

Dr. Colan—

Case of Robert Symonds; who had been with Lieutenant Giffard, 1910-13.

TARTARIC ACID. [See *Acid*.]

TAWS, E., Ice-quartermaster of "Discovery."

Dr. Ninnis—

Scurvy after sledging in North Greenland, 2564-6.

TEA. (*Unless otherwise specified, remarks refer to Sledging*.)

Analysis of Compressed Tea by Mr. Bell, with Report—

Evidence.

Sir G. Nares—

Preference for tea, 106; given for lunch in lieu of spirits formerly taken, 107-8, 193; men work better after it at luncheon, 195; greatly appreciated, 181; advantage of tea, but disadvantage of halt for, at luncheon, 192, 197-8; allowance increased if rum decreased, advantage of the change, but disadvantage of halt for luncheon, 192, 197-8.

Captain Markham—

Would not recommend additional tea, 663; tea-leaves eaten as a vegetable, did not think it would have any effect, 738; temperance men had overplus of tea, 742.

Commander Beaumont—

Men sledging did not care about spirits, except in tea, 993; given at luncheon, 994; men worked better after, 995.

Lieutenant Rawson—

It cannot be too highly spoken of, 1160.

Lieutenant Giffard—

Advantage of it, men looked forward to it, 1232; tea and spirits given separately, 1247.

Commander Aldrich—

Description of compressed tea, its advantage in measurement and strength, 1295; to what extent he used it, 1401; preference for tea at luncheon, but disadvantage of halt except when working half loads, 1296; advocates it in middle of the day, 1405; advantage of it at night, and how taken, 1401.

Dr. Colan—

Of more advantage than rum, 2021; prefers it for luncheon, 2022; men more vigorous and able to endure fatigue, 2023-4; advantage of compressed tea, 2127; chewing tea-leaves not antiscorbutic, 2141-2.

Dr. Moss—

Preference for luncheon instead of rum, 2421, 2447; work better done, 2446; preference for tea, 2475; advantage of compressed tea, 2446; better than ordinary tea, 2467; retains its flavour, and is more easily made, 2468; tea-leaves may have assisted as antiscorbutics, 2469.

Dr. Ninnis—

Tea always welcome, 2712; its comforting effects greater than rum, even when not sledging, 2716; better than rum for luncheon, but the longer halt objectionable, 2715-16; better during working hours, 2730.

Admiral Richards—

Would not exclude tea or rum, 3175; tea very much prized, 3176.

Captain Hamilton—

Warmth produced by mixing rum and tea, due to mixture, not to either alone, 3084-7; some preferred tea for lunch, 3009; tea better than rum, 3084.

Captain Hobson—

Great value of tea, 3547; men expressed themselves willing to give up rum rather than tea, 3550.

Dr. Toms—

Time it takes to make, 3757; the halt would be injudicious in checking perspiration, 3758.

Captain A. Young—

Attaches much value to tea, 3878; would take both it and rum sledging, it in preference, 3804-6.

Dr. Scott—

Tried compressed tea in China, and did not care for it, 3945; only the commoner kinds compressed there, 3946; would prefer tea to rum, 3956; considers the halt for it at luncheon injurious in excessive cold, 3956-7.

Mr. Ede—

Preference for tea over rum, 4100; should be given at mid-day when undergoing exertion, 4104.

Dr. Lyall—

Prefers rum at night and tea for mid-day meal, 4313, 4415; but objects to a long halt for making it 4313; tea good in its way, 4312.

TOBACCO, *continued*—

Mr. Bayley—

Tobacco enjoyed when sledging, 6503.

TREATMENT. [See *Scurvy*.]URINE. [See *Scurvy*.]VEGETABLES. [For those Eaten, see *Diet*; see also *Sorrel*, *Mustard*.]

Subheads 1. General.

2. Potato.

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Analysis of preserved potato—	
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Preserved carrots, by Professor Attfield with Report
Compressed cabbages, by Professor Attfield	„
„ mixed vegetables	„

Evidence.

1. General.

Dr. Colan—

What their preserved and compressed vegetables were, 1697-9.

Dr. Moss—

Desirability of taking more vegetables, fruits, &c., 2432.

Dr. Ninnis—

What vegetables he grew, suggestions for growing, 2738; peas and beans grown, 2740.

Dr. Piers—

List of, taken in former expeditions, 4677.

Dr. Macdonald—

Extent to which turnips are antiscorbutic, 4886-7, 4895-8; a small amount of potash in them, 4898.

Dr. De Chaumont—

What possess most antiscorbutic qualities, 5054; dandelion a succulent vegetable, with some vegetable acids, 5055; use of dandelions to make soup, 4964; recurrence of scurvy when dandelions failed in hot weather in the Crimea, 4968-9.

Dr. Pavy—

Dried vegetables antiscorbutic, but not so much as fresh, 5215.

Mr. Busk—

Preserved cannot be relied upon as antiscorbutics, 5249; cooking them impairs their property, the living juice necessary, 5265.

Dr. Guy—

Vegetables and fruits rank together as antiscorbutics, 5319; preserved vegetables rank next, 5319.

Dr. Buzzard—

Compressed ones useful, but not palatable or antiscorbutic, 5467, 5471; vegetable juices are depreciated in preservation, 5468-70.

Mr. Leach—

Americans use vegetables and not lime juice as antiscorbutics, 5574-5; antiscorbutic virtue of dried vegetables not yet ascertained, 5597.

Captain Feilden, R.A.—

Angelica officinalis not found north of the seventy-eighth parallel, 5977-8; it is used as a preserve, and considered antiscorbutic, 5976; a little dandelion (*taraxacum dens-leonus*) found between latitudes 82° and 83°, 6074; it could not have been cultivated from want of seed, 6075-6.

Rear-Admiral Pullen—

A small patch of ground at Fort Simpson cultivated, 6137, 6147; potatoes, barley and turnips grown, 6148-9, 6137, 6150; found some mushrooms, 6173.

Dr. Rae—

To what extent they are cultivated round the forts of the Hudson Bay people, 8868-71; use of andromeda when sledging, 8722.

2. Potato—

Sir G. Nares—

No fresh potatoes taken, 89; impossibility of carrying them, from want of room, 90-92.

Commander Parr—

Potato carried in bags, 1488; remained perfectly good, 1489; it was cooked and eaten with pemmican, 1490.

Dr. Colan—

Edwards's preserved potato supplied, 1787; description of it, 1788-9; slightly boiled before eating, 1790; was liked by the men, 1791.

Dr. Moss—

Slight mustiness in potato, 2310; but very rarely, 2311; Edwards's preserved potatoes excellent, 2433-4; whether fresh potatoes could be taken, 2435.

Dr. Piers—

Found Edwards's very good in "Investigator," 4678-9.

Commander Cameron—

The sweet one a convolvulus root, 4710; account of the native mode of cooking, 4711; it is a starchy food, and as succulent as the English potato, 4712-15; the English potato unknown where he went, 4814.

Dr. Macdonald—

Raw contains citric and tartaric acid, and is antiscorbutic, 4906; more so than when preserved, 4906.

VEGETABLES. 2. Potato, *continued*—

Dr. De Chaumont—

The preserved insufficient to ward off scurvy, not equal to the fresh, probable loss of soluble or organic salts in preparation, 5004, 5099, 5100.

Mr. Busk—

Preserved potato does not contain the antiscorbutic properties of the raw, 5266.

Dr. Guy—

Its importance in preventing scurvy, 5313-15; the antiscorbutic property due to its vegetable acid, 5376; preserved potatoes not equal to fresh, but need not be much inferior, 5377.

Dr. Buzzard—

Potatoes or vegetables superior as antiscorbutics to lime juice, 5478-9; if potatoes could be kept good on board ship, scurvy would never be heard of, 5478; suggestion to take raw potatoes sliced and preserved in molasses, 5526; to be eaten raw as a salad, 5529; raw ones more antiscorbutic than cooked and preserved, 5527.

Mr. Leach—

Antiscorbutic virtue in preserved potato not yet ascertained, 5597.

Dr. Dickson—

Preserved not equal to fresh, but cooked equal to raw, 5714, 5729.

Vice-Admiral Ommanney—

Advantages of Edwards's preserved potato, its antiscorbutic effect, 5797; raw potato given by the French as antiscorbutic, 5899.

Captain Feilden—

Allowance sledging in recent expedition very good, 6043; were cooked mixed with pemmican, 6041-4.

J. Organ—

Three sorts of potatoes in "Assistance" and "Resolute," 6598-9; preferred French sliced potatoes to Edwards's, 6600-1.

Dr. Barnes—

Raw potatoes more antiscorbutic than cooked, 7136.

Sir A. Armstrong—

Uncooked potatoes more antiscorbutic than cooked, 9161; potato is antiscorbutic, but not so much so as lime juice, 9275-6.

VEGETATION.

Dr. Colan—

A good deal of vegetation round the winter quarters, 2154.

VENTILATION. [See also *Air*. *Testing Air and Carbonic Acid in the Air*, see under *Air*. *Sylvester Stove*, see under *that head*.]

Subheads 1. General.

2. Recent Expedition.

3. Former Expeditions.

4. Condensation.

5. Advantage of heating air on admission.

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Sections and plans of "Alert," "Discovery," and "Resolute," with cubical contents of decks	22

Evidence.

1. General.

Sir J. Nares—

Difficulty of ventilating arctic ships, 216; rapid interchange of air in arctic regions, owing to difference of temperature, and consequent ventilation with a small opening, 230; increase of moisture with increased ventilation, 231.

Dr. Moss—

Suggestions for improving ventilation by metal condensers, 2415-17; impossibility of affording more space in arctic ships, 2419; large ships impossible, 2420.

Dr. Ninnis—

Suggestion to house in the upper deck with snow and make communication to it from lower deck, 2683.

Dr. Copping—

Difficulties in ventilation have always existed in arctic ships, 2911; impossibility of carrying out on principles used on shore, 2912; increase of cubic space of air by a deck-house would involve difficulties in warming, 3912; difficulties of navigation render large ships unadvisable, 2913; impossibility of renewing air sufficiently often, if a high standard of air is accepted, 2864-9.

Admiral Richards—

Snow walls could not be substituted for canvas housing, 3165-6; they would decrease the area of the deck, 3165; the suggestion of covering a large space of the deck not practical, 3168; difficulty of ventilation, owing to coldness of air preventing its renewal, and limited supply of fuel, 3205-6.

Sir L. M'Clintock—

The necessity of keeping up the temperature limits the change of air, 3333; advantage of increasing ventilation by introducing heated air, 3334-5; such ventilation could be more applied, but is not necessary, 3336; the stove pipes and opening and shutting of doors keep the air pure, 3337-8; advantage of a snow-house over upper deck, 3322.

VENTILATION. 1. General, *continued*—

Dr. Toms—

The difficulty is the admission of such cold air, 3647, 3655.

Dr. Macdonald—

The lining should be of thick non-conducting material, 4826; the hot-water system superior to hot air, 4831; but induced consumption in Haslar Hospital, 4832; hot-water pipes desirable for arctic ships, except as to waste of fuel, 4833; openings between the timbers commanded by valves would ensure the escape of foul air, 4835-6, 4840; this would be applicable to arctic service, but not to the ships sent, as provision had not been made in the original design, 4837; ventilation should form part of the original design of ships, 4840; means of escape of foul air, the proper way; an escape should be made between the deck and the ship's side, 4875; artificial means required in a confined space, for renewal of air, 4872-3; in such places cannot be renewed, without a draught prejudicial to health, 4873; destructive effect on rats of draught in a sewer, 4873; difficulty of renewal increased in cold climates, 4874; draughts might be obviated by larger spaces, and dividing the air in two, 4875; ventilation should be by extraction of foul air, not by injection on the plenum principle, 4927; method used in the Queen's sleeping cabin on board the "Royal George" would have been perfect if there was a special channel for the admission of air, 4928.

Mr. Busk—

Cubic space on board the arctic ships too small for constant residence, not if merely occupied at night, 5303; the difficulties of ventilation probably insurmountable, but the effects of bad air not a chief cause of scurvy, 5304-5.

Dr. Guy—

The space the crews had inadequate to preserve health where there is much confinement, 5403; difficulty of renewal of air in confined spaces, especially with low temperatures, owing to draughts, 5405; increase of difficulty in ventilation in ships' cabins with want of opposite openings, 5409.

Mr. Leach—

But little to complain of in the ocean-going merchant ships as to accommodation of seamen, 5579; the minimum allowed, seventy-two cubic feet and twelve superficial feet, 5580-81; no system of heating in ocean-going ships; he objects to stoves in coasters, 5582-3; not necessary, 5584; difficulties in arctic ventilation, 5591-2.

Sir A. Armstrong—

Difficulty in keeping lower deck of polar ships pure, 8948, 9064; owing to difficulty of renewal of air, the cold being one obstacle, 9072-3.

2. Recent Expedition—

Sir G. Nares, "Alert"—

Impossible to remove snow from skylights till May, 181; lower deck very dark even then, 181; disadvantage of dark decks with bright sun, 181; "Alert's" living deck less damp than "Resolute's," 216, 225; large extra houses on upper deck at the head of each hatchway, 216; "Alert" heated by service stoves distributed about decks, 217-18; holds did not require heating, 217; funnels from stoves turned into ventilators, 217; how the funnelling was led, 220; difficulty in producing uptakes, 217; very little ice inside "Alert," 223; the state of the air reported satisfactory, 227; ventilation dependent on stoves and hatchways, 228; and two tubes as down-takes, 229; stove funnellings the absolute uptakes, 229; the system as perfect as necessary, 230; what covering of snow was placed on upper deck, 232; holds closed to outer air, 232; but in communication with lower deck, 232; consequently temperature in them never low, 232; "Alert" thoroughly dry, 233; no foul smells till after the thaw, 234; alteration of a few berths, and ship's steward taken out of cabin owing to dampness, 235; omission to refer to snow houses round the hatchways, their advantage as condensers and ventilators; apparent small size of lower deck due to stores stowed there, these were landed and lower deck enlarged to twice its size, 9303; lower deck extended to abaft the mainmast in winter quarters, 9303; good drying-room, 121.

Commander Beaumont, "Alert"—

The "Alert," even with the extra men, had better winter accommodation than the "Discovery," 1003-4.

Commander Pelham Aldrich, "Alert"—

Great pains taken in ventilation, under supervision of the captain, 1303; the drying-room carefully looked after, 1303; the housing fitted with hatches which were thrown back, 1303.

Dr. Colan, "Alert"—

Not entirely satisfied with heating by stoves, or ventilation, 2172; except the quartermaster of the watch, all the men were below at night, 2183; whether satisfied with hygienic condition of the ship, 1635-6; usual allowance of cubic space given for men to sleep in, 1637; the lower deck extended further aft, 1637; the cubic space sufficient in his opinion, and the hygiene as good as could be under the circumstances, 1640; ventilation and warm-

VENTILATION. 2. Recent Expedition, *continued*—

ing pushed to extreme compatible with external cold, 2048; account of the ventilation established, 1650; perfect in the way of clearing the deck, 1650; difficulty in admitting external air owing to cold, 1650; they had sufficient air between decks, 1653; suffered from moisture, 1654; due to vapour given off by men, 1655; amount that can be given off, 1656; fresh air required to hold this in solution, 1657-8; no inconvenience caused by the moisture, 1659; method of treating excrementitious matter, 1660-62; no smell on the upper deck, 1663; hygienic condition of the sick room, 1843.

Dr. Moss, "Alert"—

Arrangements in, for ventilation and warmth, 2264, 2413; doors frequently open on to main deck, 2264; what openings there were into the outer air, 2266; all of them constantly available for change of air, 2267; the area of the openings, 2268; complaints by men of draughts, 2268, 2411; difficulty in effecting satisfactory ventilation, 2282-3; chiefly from coldness of the outer air, 2283; advantage of air being admitted after heating, 2286; impracticability of frequent renewal of air with means available, 2409-10; difficulty in equalising supply of cold air; complaints made of cold and draughts, 2411.

Admiral Richards, "Alert"—

Considered her spacious and very comfortable, 3108.

Sir L. M'Clintock, "Alert"—

Had the usual space for the number of men, 3258-61.

Dr. Macdonald, "Alert"—

Deficient in air space and provision for escape of air, 4826; want of it in officers' cabin, 4834.

Mr. Leach—

Considered the "Alert" and "Discovery" were closely packed, 5586-7; without as much space as usual in the navy, 5588; but allowance for retention of heat and stowage necessary, 5589-90; difficulties would exist in renewal of air, 5591; the cold outer air adding to them, 5592.

Captain Feilden—

The air of the ward-room of "Alert" wonderfully good, 5923; where his cabin was, 6048; warmed by the ward-room stove, 6049; generally above 32° in winter, 6050; anything just below freezing an advantage, less drip, 6056; its ventilation good, 6051; arrangement of an indiarubber tube communicating with the open air, opening or closing at will, 6051-3; could thus get air in or exclude it, 6055; an uptake in the ward-room, which ventilated his cabin, 6057-8.

Thomas Rawlings, "Alert"—

The "Alert" had more room than any ship he had served in, 7625.

Color-Sergeant Wood—

The accommodation of the "Alert" inferior to most men-of-war owing to the conditions of the climate, 7858-63; the space for living is about the same as in most ships, 7859-62, 7864; but the ventilation inferior, as the hatchways could not be opened except in summer, 7864-7; there were up-takes and down-takes of stove funnelling, which were useful, 7865-7; they were successful, 7869; besides the galley fire one stove on the lower deck, 7873-4; it was kept burning all night, 7875; the lower deck cleared during the forenoon, 7877; the lower deck not sweet, 7957; had a close and damp feeling through the day in winter, 7958-9; impossibility of remedying it, 7960.

Captain Stephenson, "Discovery"—

Arrangements for drying room, and for carrying off vapour from it, 380; for cleaning and drying the lower deck and ship below, 381-3; deck clothes, how far used and cleaned, 384-6; ironwork between decks covered with leather, 387; more cubic space desirable on lower deck, 437.

Commander Beaumont—

Ventilation of the "Discovery," 1005; good in preventing moisture, 1017; no moisture in cabins aft the ward-room, 1027; the moisture due to confined space and steam from galleys, 1029; only froze on metal bolts at night, 1007, 1020; no distress in breathing from moisture, 1018; holds and storerooms sweet, clean, and dry, 1019; to what extent frost formed in holds, 1020; carbolic acid used as a disinfectant, 1021; where required, 1022; what part of "Discovery" warmed by hot water, 1023-7; otherwise the method was similar to the "Alert," 1025; ventilation of lower deck attended to as far as possible, 1181; it was never perfect, 1182; but what could be was done, 1183.

Dr. Ninnis, "Discovery"—

Want of larger supply of fresh air, 2535; and means of arresting constant wetness between decks, 2535; impurity not to the senses greater than an ordinary ship, 2543; impossibility of remedying the impurity, 2538, 2546; efforts to do so, 2546; advantage of inverted funnel over the galley, 2685; in decreasing the moisture and smell of cooking on lower deck, 2685-6.

Captain Hamilton, "Discovery"—

Difficult to warm with stoves, owing to funnel, 3072.

VENTILATION. 2. Recent Expedition, *continued*—

Sir L. McClintock, "Discovery"—

Space for crew smaller than usually allowed, 3256; more officers on board, 3256, 3311-13; otherwise the arrangements of the recent expedition superior to others, she had less space than he wished for, 3311-13; space for crew encroached on by building an officers' cabin, 3331.

Alexander Gray, "Discovery"—

More room and comfort on board the "Discovery," 7317; the main deck comfortable, but not warm, 7320-21; not stuffy, 7322; or extraordinarily wet, 7323-4; as much or more wet in whalers, 7323.

Mr. Emmerson, "Discovery"—

Everything they could wish for, 8087; but lower deck very damp in winter, 8165; but the carpet on the lockers was always wet from condensation, 8087; plenty of room on the lower deck, as much as usual in the navy, 8808-9; sat on their clothes lockers, 8091; no ventilation under them, 8092-3; uptakes put to different places, 8097; everything tried, but nothing stopped the condensation, 8098; formation of ice in the house over the hatchways, 8099.

William Jenkins, "Discovery"—

More room than in other ships, 8376; no possibility of preventing condensation under the situation, 8378, 8431; the mess place was very comfortable, 8379; a good deal of damp in the lower deck, 8430-1; its increase with increased fires, 8431.

3. Former Expeditions.

Sir G. Nares—

"Intrepid" and "Pioneer" warmed in the ordinary way, considered superior to the Sylvester stove, and the ships were used as hospital ships, 9303.

Admiral Richards, "Assistance" and "Resolute"—

The "Assistance" very comfortable, 3108; advantage of its teak deck, 3108; a good deal of drip from ice forming overhead, 3109; the wet nearly cured the second winter by wooden hoods over the hatchways, 3110, 3210; they acted as condensers, 3167; wet only produced discomfort, 3110; the moisture ascended to the hatchways and congealed there, 3203; great comfort in absence of moisture, but doubts any effect on health, 3204; the "Resolute" not fitted in similar manner, 3113; decks of "Assistance" always clear for five hours a-day, 3205; object to get rid of vapour, success the second winter, 3210; means taken to promote ventilation, 3213.

Sir L. McClintock—

"Enterprise" lower deck more uncomfortable than "Investigator's," and health worse, 3278-9; "Investigator" more healthy, having a better lower deck, 3278; had more cubic space than "Discovery," 3257; "Fox," snow porches built over hatches, 3322; to retain warmth, 3323; ventilating tubes put in remote corners, 3338; there was no obvious impurity of the air, 3339; dampness due to insufficient ventilation, 3367; ventilation of "Fox" was by stoves, with a few tubes as uptakes, 3383.

Dr. Toms, "North Star"—

Arrangements for ventilation, cleaning decks, 3554; difficulties occasioned by her being on her beam ends, 3554; she had two decks, 3561; the men lived on the same deck as the officers, 3561; no one slept on the lower deck, 3562-3; ventilation sufficient for health, decks being cleared every day, 3564; air changed by funnels and when hatchways opened, 3565; the covering of the hatchway, 3566-70; deck cleared for about three hours, air admitted, 3648-9; and impurity thus to some degree prevented, 3651; but not sufficiently, 3652; more could not be done without damage to men by keeping them too long out, 3653.

"Pioneer"—

Not so comfortable as "North Star," having a less proportionate space, 3593-5.

Captain Allen Young, "Fox"—

The "Fox," during drift of ice, housed in ordinary manner of royal navy ships, 3812; dryness of the ship, 3769, 3813.

Dr. Scott, "Intrepid"—

Accommodation better than "Resolute," 3889; he suffered from dripping at night, 3899; the lower deck comparatively dry, 3900; ventilation by an uptake, 3901-2; air admitted by the hatchway, 3903; which had a double door, 3904; the galley also was a downtake, 3906; the deck was pure and sweet, 3907.

Mr. Ede, "Assistance"—

Warmed by Sylvester stove, 4050; ventilation was by it and opening of hatchways, 4055; had downtakes, 4056; no uptakes, or tanks over hatchways, 4057-8; the air tolerably pure, the lower deck emptied by sending men out, 4059; not much drip, 4060; ventilation better than in "Resolute," 4062; having more height between decks, 4063; the moisture was driven off by the Sylvester stove 4237; no difficulty in ventilation in the frigate in which he saw scurvy, 4222-3.

Dr. Lyall—

Ventilation of "Assistance," 4267-87; improvement the second winter, 4267, 4281; by building a house over the

VENTILATION. 3. Former Expeditions, *continued*—

main hatchway, 4267-9; the only one used to go on deck, 4273; thus preventing rush of cold air in when opened, 4267; uptakes from fires, cooking apparatus and stoves, 4268; less drift, 4282; tanks with manholes over the fore hatchway for condensation of heated air, 4274-5; a Sylvester stove used, 4277.

Dr. Piers—

In "Investigator," metal ventilators as uptakes, through the deck and awning, 4490-91; downtakes by the hatchways only, 4492-3, 4660; there was a hatchway for the men forward, 4661-3; much drip from the beams of the upper deck, constant wiping, 4494; in some of the officers' cabins the moisture dripped, 4497; only one hatchway used, 4501-2; extent to which this was housed over, and what doors there were, 4503-6; they never suffered, owing to ventilation, 4659.

Vice-Admiral Ommanney—

Of "Assistance," pains taken by Captain Austin, 5731; deck kept as clear as possible, 5731; apertures of the hatchways kept open, except in extreme cold, 5731; temperature from 49 to 50 degrees on lower deck, 5731, 5791; cowls fitted for carrying off vitiated air, but no downtakes except hatchways, 5732; advantage of these arrangements in ventilation and temperature, 5792-3; his cabin the coldest but seldom below freezing point in the morning, 5741; the fresh air from the hatchways not heated previous to admission, 5794; that from the Sylvester stove was, 5794; the "Assistance" had more space than the "Alert," "Discovery," or "Resolute," 5881; the ventilation in her as perfect as possible, 5882.

Rear-Admiral Pullen—

"North Star" had two decks, the main for berths, the lower for work, 6215; advantage of this, 6216; ship was damp (whilst on shore) when on her broadside, but it was cleared off when upright, 6218; was warmed by Sylvester stove, and stoves, 6217.

Mr. Bayley, "North Star," 1848-49—

Warmed by stoves, had not Sylvester stove, 6252-3; much dampness, 6311; means of removing it, 6312; warming apparatus rigged up impromptu, 6315; not so comfortable as the "Assistance," 6519.

"Assistance," 1852-54—

Pleasanter than "North Star," 6276, 6520; owing to Sylvester stove and better accommodation, 6277; not much moisture to complain of, 6281-2, 6467-8; improvement the second winter in hatchways and awnings, 6284-5; description of door over hatchways, 6470; no complaint of admission of cold air, 6471; lower deck comfortably warm at night, 6453; deck covered with a foot of snow, 6463-4; advantage of this, 6465; lower deck very comfortable, 6475.

J. Organ, "Resolute," 1850-51—

Better ventilation than "Enterprise," 6551; good ventilation and no damp, 6724-5; "Assistance" good also, 6724-5.

"Enterprise," 1848-49—

Lower deck very damp, much moisture and ice, 6533-6, 6718; partly due to galley, 6720; lower deck was not crowded, 6719-20; and did not smell stuffy, 6723; ventilation defective, compared with other ships, 6797; more moisture than in his other ships, 6798.

Mr. Murray, "Enterprise" 1850-55—

Better ventilated than "Investigator" in 1848-49, 6836; ventilation in first winter in 1850-55; housing and warming, 6853; what doors the hatchways had, 6854; a tank over the main hatchway as condenser, 6854-6; mainhold partly used for living in, 6863-4; and washing clothes, 6867; better ventilated than "Investigator," 6949.

"Investigator," 1848-49—

Had cumbersome chests on the lower deck, not so much ventilation as the "Enterprise" in 1850, 6834a-9.

Dr. Barnes—

Ventilation of the "Dreadnought" well cared for, 7083.

Sir A. Armstrong, "Investigator"—

The supply of coal was reduced from 70 to 50 lbs. a day, 8946; funnels for ventilation opening above the housing 8948; rarified air would rush out like steam, 8948.

4. Condensation.

Sir G. Nares, "Alert"—

Wet in bedding, on "Alert," from condensation, with men sleeping near a hatchway, 119, 215; advantageous arrangements for drying-room, and escape of its condensation, 121; larger area per man than on "Resolute," 226; some amount notwithstanding, 216; officers' cabins the dampest part, 216.

Commander Pelham Aldrich, "Alert"—

Men told off to wipe it off the beams, 1303.

Color-Sergeant Wood, "Alert"—

Amount of it, 7870-71; it was wiped up, 7872; not so much at night, 7876.

Captain Stephenson, "Discovery"—

Condensation in winter great on lower deck, 383.

Commander Beaumont, "Discovery"—

A good deal, 1006-8; it existed on the living deck, and chiefly during cooking and sleeping, 1185.

VENTILATION. 4. Condensation, *continued*—

- Alexander Gray, "Discovery"—
Amount there was on hammocks, 7206-8, 7326-32.
- Mr. Emmerson, "Discovery"—
Carpet on lockers always wet, 8087; lower deck very damp in winter, 8165; nothing stopped it, 8098; formation of ice in the house over the hatchway, 8099.
- William Jenkins, "Discovery"—
No possibility of preventing it when in bed, covered his hammock with an oil-skin, 8377, 8431.
- Admiral Richards—
A good deal of drip on "Assistance" from ice forming overhead, 3109; wooden hoods over the hatchways acted as condensers, 3167; the moisture ascended to hatchways, and congealed there, instead of on the beams of sleeping deck, 3203.
- Dr. Toms—
Much in lower part of upper deck of "North Star," 3572; arrangements for removal, 3554, 3648-9, 3654.
- Captain Allen Young—
Pains taken by Sir L. M'Clintock to clear it away and dampness on the "Fox," 3769, 3813.
- Dr. Scott—
He suffered from dripping at night in "Intrepid," 3899.
- Mr. Ede—
In "Assistance" rather troublesome, 4236.
- Dr. Lyall—
Froze on lower part of upper deck of "Assistance," 4283; the men suffered from it at night, 4285; and he had it in his cabin, 4286.
- Dr. Piers—
In "Investigator" much drip from the beams of the upper deck, constant wiping, 4494; condensation froze even in cabins, 4497.
- Dr. Macdonald—
Would be got rid of by more frequent renewal of air, 4838.
- Mr. Bayley—
A little drip on "Assistance" the first winter, 6460; but not distressing, 6466.
- J. Organ—
Deck of "Resolute" would have been wet if not wiped, 6726-7.
- Mr. Murray—
A tank over main hatchway of "Enterprise" as condenser, 6854-6; frosted moisture cleared out of it, 6856-7; not so much drip as in "Investigator," owing to good ventilation and a fire in the mainhold, 6858-9; to what extent it existed on "Enterprise," 6929-31.
- Vice-Admiral Ommanney—
In "Assistance" the moisture on the surface of the bolts coming through on lower deck frozen, 5738; no drip on the beds of the officers, 5741.
- Captain Feilden—
In "Alert" a good deal in remote corners, 5924; plenty of drip from the beams at night in his cabin, 5925; which he caught in a blanket over his head, 5926; it cannot be entirely prevented, 5927.
5. Advantage of Heating Air on admission—
Dr. Moss, Dr. Colan, Dr. Toms, Dr. Barnes, Sir A. Armstrong, Admiral Richards, Dr. Dickson, Dr. Macdonald, Dr. Piers, Mr. Leach, and Vice-Admiral Ommanney—
Advantage of heating air, 1650-51, 2286, 3208-10, 3656-9, 4666, 4826, 4840, 4876-9, 4883, 5593, 5644-6, 5883, 7084, 9073-5-6.

WASHING—

Regulations for drying-room of "Alert," Appendix No. 5.

Evidence.

- Sir G. Nares—
Arrangements for cleaning the lower deck, 118; men to keep it dry, 119; regulations for washing (drying-room), 120; measures for ensuring washing, 122; men supplied with usual tubs, 123.
- Captain Stephenson—
Measures for washing one night a week, 373; chill taken off the water for the purpose as far as possible, 373, 378; the special space assigned, 374; arrangements for washing clothes, each of four divisions one day a month, 375; personal cleanliness sufficiently ensured, 376; bathing continued through winter, and considered a luxury, 377; arrangements for drying clothes, 379; means of carrying off the vapour of drying-room, 380.
- Commander Aldrich—
Every officer and man had use of drying-room without distinction, 1303.
- Dr. Colan—
The medical examinations were satisfactory as to cleanliness with most men, 2035.

WASHING, *continued*—

- Vice-Admiral Ommanney—
Arrangements in "Assistance" for washing once a fortnight, 5812-13.
- Mr. Bayley—
Arrangements in "Assistance" for washing, 6278-80.
- J. Organ, "Resolute"—
Arrangements for washing and washing clothes, 6753-6; warm water supplied, 6756; petty officer of the mess supervised it, 6760-62; cannot wash sledging, 6759.
- Mr. Murray, "Enterprise," 1850-55—
Arrangements for washing, 6867.
- Sir A. Armstrong—
No regular system of washing in "Investigator," men got water once a fortnight, officers tepid water once a week, 8947.
- WATER—
- Sir G. Nares—
Salt water ice covered with minute dust, 105; water of "Alert" very good, that of "Discovery" perhaps brackish, 94; method of obtaining it by cutting ice, 97, 102; no fresh water lakes near on shore, 99, 100; reason why "Discovery's" water may not have been as good, 98; no bad effect from its use, 101; probably did not use it generally, 101; how snow and ice was melted, 103; it was at once drinkable, and not flat, 104-5.
- Captain Markham (Sledging)—
Good water obtained by autumn parties, 562; drinking water, how obtained, 637; very good (except once or twice), 639; only able to procure it for meals, 640; had to melt all they drank, 642.
- Commander Aldrich (Sledging)—
In autumn chiefly melted from snow, 1320; also in spring, 1370; it was good, 1321.
- Commander Parr—
What they used, 1502.
- Dr. Colan—
Obtained from a floeberg, 1664; no difficulty in obtaining a sufficient quantity, 1665; how obtained, was tested for saltness, 1666-7; chemical examination very satisfactory, 1668.
- Dr. Moss—
Satisfactory results of examinations of water, 2287-9; very pure water, 2289; how obtained, 2288-91; pure when taken from old ice, 2294; how when sledging it was obtained, 2293; officers in command understood how to take it, 2295; it was good; very little salt in it, 2296.
- Dr. Coppinger—
Examined it, but not quantitatively, 2853; had no apparatus for estimating its chlorine, 2854.
- Captain Hobson—
Difficulty in obtaining it, in sledging from "Fox," 3509; owing to want of fuel, 3512; suffered from the want of it, 3510-11; drank it only in tea and cocoa, about a quart a day, 3512-13.
- Dr. Toms—
Drinking water obtained from melted snow in "North Star" and "Pioneer," 3715; was satisfied with quality, 3716.
- Captain Feilden—
Good drinking water obtained in the recent expedition, 6046-7.
- Alexander Gray—
Got enough water, 7476-7; could not carry any at first owing to the cold, 7479.
- William Jenkins—
Sledging, was good, but sometimes a little salt, 8464-5.
- WEIGHTS. [*Of Men, see Health and Medical Examinations. Sledging, see Sledging.*]
- WHALERS. [*See Merchant Service.*]
- WHEAT—
- Dr. Ninnis—
"Polaris" wheat grown, 2738; it was quite sound in spite of prolonged exposure, 2739.
- WINE. [*See Spirits, Scurvy, Diet.*]
- WINSTONE, GEORGE, A.B., of "Alert"—
Commander Parr.
His comparative exemption from scurvy, he smoked and chewed tobacco, 1469-72.
- WOLLEY, WILLIAM, A.B., of "Alert." (Also spelt Woolley).
Dr. Colan—
Attack of scurvy, a similar case to Lorrimer's, 1900-3; his case (Lieutenant Giffard) 1220; lime juice being carried when ill, 1222.
- WYATT, B., A.B., of "Discovery"—
Dr. Colan—
Scurvy on return from his own ship, 1879-84.
- Sir A. Armstrong—
Remarks on his case, 9258-60.

YORK FACTORY. [*See Hudson's Bay.*]



